Report
of the
CSIR Review Committee

Towards A New Perspective

December 1986

December 31, 1986

The Prime Minister,
President, CSIR,
NEW DELHI.

Sir,

We have great pleasure in submitting herewith the Report of the Committee set up to review the CSIR.

Yours faithfully,

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Chairman

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PREFACE

1. This Report suggests a set of measures which would integrate the CSIR system with the mainstream of our economic and industrial activity. The constitution of our Committee was based on the obvious perception that the work of the CSIR was out of step with the needs of the nation. If the CSIR has failed to live up to expectations, it is, we feel, very much a collective responsibility. The need for radical change in the CSIR, and the environment in which it functions, is stronger today than ever before because we are setting our sights higher. It is also an expression of the belief that a deliberate transformation can be engineered in a society like ours through the conscious use of science and technology. It is also a recognition of the fact that the emerging phase of our industrialisation is pivoted around research and technological innovation. We have in fact arrived at a stage where it is both necessary and possible to bring together the world of science and the realm of technology in the economic sphere of production. We believe that the CSIR has the ability and the willingness to be in the forefront of such an exciting endeavour.

2. The CSIR is an open system, unlike the other scientific organisations in the country, and has been the most probed. The criticism that has surfaced has forced all of us to focus attention on the need to restore a meaningful role for the CSIR. Beyond a point, criticism, particularly of the kind that CSIR has been subjected to, can sap the morale and become counter-productive. We think that scientists and technologists working against heavy odds in a traditional society, perhaps more than anyone else, need recognition and deserve encouragement. They should always get the feeling that they have responsive allies in the highest echelons of our polity. It is for the Government to provide sustained commitment and direction without expecting instant miracles. If that happens, the scientific community will not be found wanting. At the same time, we would very much like the scientific community in the CSIR to find in this Report a genuine reflection of the political leadership's heightened concern

to energize the vast and sprawling infrastructure created over the years, to carry the country forward at a faster pace.

3. The CSIR is a loose confederation of 39 different laboratories rather than a cohesive system working for concrete goals and specified objectives. Yet, it has responded well in times of need when it has been set a task. Some of its laboratories have made significant contributions. It has created a reservoir of scientific talents, built an infrastructure for research and development and nurtured many of our eminent scientists and technologists. However, we hope that we shall not be sowing the seeds of panic and detracting from its achievements when we draw attention to its weaknesses. We are aware that some of its difficulties are historical in origin and derive from the environment in which it has had to function. We are conscious that the resources allocated to CSIR have not reflected the range and breadth of its activities. Nevertheless, there has been a disproportionate emphasis in terms of work on known-products and known-processes akin to re-inventing the wheel. The work of the CSIR, in some areas, can be characterised as solutions looking for problems. At times, effort has been expended in the pursuit of research and development which is best carried out in its place of use. On some occasions, scarce resources have been directed to the pursuit of marginal tasks.

4. The blame for what has gone wrong cannot be laid at the door of the CSIR alone. It is a collective responsibility. It is as much a failure of the other two major actors on the stage: the industrial system and the regime of policies. Therefore, the reform of the CSIR system is a necessary condition but not sufficient for realising our expectations and objectives. The contribution of the CSIR system is significantly influenced by the planning process. If planning for R&D and technological development is not intimately and inextricably woven into the very fabric of our macroeconomic and sectoral plans, little of tangible value will emanate from our research institutions. The integration of R&D into our plans has to go beyond highlighting its importance in our plan documents. For this reason, we have stressed the importance of an integrated set of economic policies which would accelerate the absorption of imported tech-

nology, foster the development of indigenous technology and create an environment that would be conducive to innovation. It is our judgement that, at the present conjuncture, the role of the State in the development of technology is paramount. This is a major theme of our Report.

5. We think that, in the long run, the natural habitat for basic research is in the Universities, just as the proper place for industrial R&D is in the manufacturing enterprises. In such a world, the CSIR system would be at the cutting edge of science and technology, always one step ahead with an eye to the future and concerned with high-impact science and technology where social benefit would not be ensured by private initiative. In the transition period, CSIR has a role to perform because most of our Universities are still at a second remove from excellence in research, and the industrial sector has not yet felt that compulsion to do what we expect of them. In the interim, CSIR has to be the seed-bed for both science and industry to grow to maturity. The educational system must be provided with the wherewithal and the orientation so that it can assume its mantle. The industrial sector should endeavour to develop a symbiotic relationship between research and production. When this happens, CSIR would be released from the shackles imposed by considerations of immediate relevance so that young minds could wander into the realms of the unknown, continuously advancing the frontiers of knowledge and striving to achieve what is still beyond.

6. That technology is going to be the key to our economic renaissance is indisputable. The real issue is how to manage science and technology so that the full potential is harnessed for national good. The administration of scientific institutions within the governmental system, tends to become an end in itself, instead of a means. A cadre of trained managers from the community of scientists is, therefore, a must for the application of modern methods of organisation and management in institutions of this nature. Hence, our proposal for establishment of a Training Institution to be run by the CSIR. Such an Institution would help bridge the gap between what CP Snow termed the two cultures.

7. We have approached our task in a constructive spirit with an eye to the future. The past is past. We have, therefore, not sought to find fault or apportion blame. What is more, we have not attempted to evaluate the performance of each individual laboratory in the CSIR system. This, we believe, was beyond our terms of reference. Indeed, given the range of activities and disciplines in the CSIR system, it was beyond the competence of any single Committee. Such a review should, of course, be carried out at regular intervals, say every five years, so that the CSIR system can overcome its weaknesses and build on its strengths.

8. The observations that we have made, the changes that we have suggested and the recommendations that we have put forward may, at times, appear somewhat harsh, but these spring from the need we have strongly felt to get away from an ambience in which science has perished while a few scientists have flourished. This is an alternative to ossification which stares CSIR in the face. We hope that this Report would help, in some ways, in making that alternative a reality. It is a paradox that as a nation we have a fascination for revolution but an abhorrence for change. India's future as an economy and a society which can harness technology for development depends on how soon, and how well, we can extricate ourselves from this syndrome. A regenerated and vibrant CSIR system, as we visualise it, can be a motive force in this process.

9. This Report has many debts. In its preparation, we sought the advice and counsel of some eminent scientists, technologists, and economists. We are grateful to them for their helpful response. They were generous with their time and shared their experiences with us. Some of our ideas originated in these discussions and some matured thereafter. We owe them a debt of gratitude. There were others, too numerous to be named individually, who also helped us. A few took the trouble of sending us written notes in which they had distilled their experience of the field and projected its vital essence. They would find some of their ideas reflected in the Report. Having said this, I must make it clear that nothing in the way of opinion or judgment expressed in the Report is attributable to anyone but us.

10. We are grateful to the CSIR Headquarters for providing us with logistic and secretarial assistance. The Director General, Dr. AP Mitra was of particular help to us in providing support without which our work would have remained unfinished. He offered invaluable suggestions to sharpen and temper some of our views. We were struck by his faith in the future of the CSIR, a faith we share.

11. We are deeply indebted to the Directors and the scientists of the CSIR laboratories for all the courtesies they extended to us. It was their willingness to entrust us with their experiences and the sincerity with which they shared their views which helped us in understanding the state of the art. Quite a number of ideas that we put across were discussed with them. To some, they lent their fullest support and to others they lent their ears.

12. I would also like to acknowledge the cheerful and tireless efforts of my personal staff, Madan Kumar, TV Narayanaswamy, and George Mathew who worked with cool disposition and endless patience under the pleasant and exacting supervision of my Private Secretary, AP Mehta. They patiently typed various versions of the manuscript and never grudged working beyond the limits of their endurance.

13. Jairam Ramesh, a vibrant talented young man gifted with an incisive mind, provided prodigious support through never-ending versions of notes and inputs for consideration. He read our drafts with a critical eye and his knowledge of industry and technology was particularly helpful.

14. I would like to express my deep appreciation for the hard, painstaking work put in by Dr HR Bhojwani who worked as Secretary of the Committee. He worked with meticulous care, endless patience, and tremendous devotion. He coped with the tensions and pressures of the work with admirable fortitude. He coordinated the Committee's work effectively, and contributed to the draft by helping us with his knowledge and experience of the CSIR. We greatly appreciated his loyalty to his own organisation, his intellectural scruples, and the unflinching devotion to his duties for the Committee.

15. The Members of the Committee represented a unique collaboration of persons and an unusual combination of talents, with expertise in science, technology, management, and economics. Each brought a unique perception to bear on the common issues of our inquiry. They put in extraordinary hours and matchless care into the making of the Report. From the intense discussions and deep deliberations, we were able to arrive at a collective thinking which made for consensus. They contributed towards the shaping of the core ideas which, in the ultimate, vitalised the Report. I am deeply indebted to them for their cooperation and untiring efforts, without which this Report would not have been possible. Now that the work and the Report is over, the Members have dispersed and I feel diminished without them.

16. We are aware of many possible omissions, but, for want of time, we have decided not to hold back our views until all matters of importance are settled and all complex issues are resolved. We are also conscious that some of what we have said in this Report, others have also said before. But, I think that the time has now come for such reforms. Long ago, as Aristotle said, "if nothing depended on time for its realisation, everything would already have happened".

ABID HUSSAIN
CHAIRMAN

31st December, 1986

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1 OVERVIEW

PREAMBLE

1.1 As the twentieth century draws to a close, it is increasingly obvious that science is not simply a matter of intellectual curiosity which can be confined to the precincts of laboratories alone. Indeed, the experience of industrialisation in the world suggests that the systematic application of knowledge derived from scientific research to the sphere of production, through the development of technology, is one of the major sources of economic growth. The usual perception is that the causality runs from scientific knowledge to technology for production. But technology is a much more complex phenomenon which cannot be reduced to the application of prior scientific knowledge. The influence of technological concerns and production needs on the growth of scientific knowledge, the reverse causation, is much less recognised. The interaction between science and technology is strategic in the process of development because neither is exogenous to economy and society. As a matter of fact, industrialisation inevitably transforms science into an endogenous activity which is shaped by technological and economic considerations.

1.2 Such interaction between science and technology on the one hand and economy and society on the other, is borne out by the history of contemporary industrialised societies. Times have changed since then. For one thing, scientific research is expensive, and that matters in situations where resources are scarce. For another, when it is directed towards technological development, it can yield large economic returns. It is for this reason, perhaps, that the late industrialisers in Asia, as also elsewhere in the world, recognised the fundamental importance of science in the catching-up process of development. The more successful among them, particularly Japan, sought to draw upon the available reservoir of scientific knowledge and placed increasing emphasis on the interaction between the world of science and the realm of technology in the economic sphere of production. In this manner, the talents of the scientists in research

were closely interwoven with the needs of the users in production, through appropriate institutional mechanisms, so that science and technology worked in tandem, rather than in parallel, for the objective of industrialisation.

1.3 The perceptions in India, at the time of independence, were similar. The founding fathers of the nation recognised the significance of science for industrialisation and, in anticipation, created the CSIR. In retrospect, there can be little doubt that the CSIR ushered into India a culture of scientific research and a milieu which created talents in science and innovation in ideas. During the four decades since then, there has been significant progress and, today, the CSIR system spans practically the entire range of sciences. Its contributions are both tangible and intangible. The CSIR laboratories have made some useful contributions. There is now a reservoir of talented scientists in the system which represents an accumulation of human capital. What is more, as the pioneer scientific agency in the country, the CSIR has provided a springboard for ideas and activities in the realm of science and technology. At the same time, it has served as a nursery which has, in the early stages, nurtured the growth of many talented scientists and some excellent institutions.

1.4 Yet, the CSIR system has not lived upto expectations. It has not provided much in terms of scientific breakthroughs or advances in the frontiers of knowledge which have received international recognition. It has been unable to develop technologies which would meet even the most agonising needs of our economy and society, let alone facilitate modernisation. The successes and the strengths are matched by the failures and the weaknesses. In the perception of some, the CSIR system appears to be unwieldy, if not grotesque, and gives the impression of unplanned growth as also of unfinished work. There are vast variations in the calibre of scientists in different laboratories, which does not always conform to standards of excellence. There is no clear sense of direction. The major failure, perhaps, is its inability to transform scientific results in the laboratory into technologies for industrial production. What is more, there has been a tendency to reinvent the wheel by placing disproportionate empha-

sis in terms of work on known-products and known-processes. It has now become necessary to transcend the limitations, mobilize the resources and harness the talents of the CSIR network, which is capable of addressing itself to the economic and social problems of the nation. In the pursuit of this objective, it will be essential to restructure the CSIR, towards which we have developed some ideas in this report.

DIAGNOSIS AND EVALUATION

1.5 As a first step, it is essential to evaluate our experience in the CSIR, for meaningful perceptions can only be based on a clear diagnosis. The problems of the CSIR are manifold and complex, some of which are its own creation while some others are a consequence of the environment in which it has developed. It is therefore exceedingly difficult to disentangle cause and effect. Nevertheless, it is possible to discern the major symptoms of what ails the CSIR.

1.6 First, the CSIR began life with a multiplicity of objectives which was, to some extent, inevitable in the early stages of our industrialisation and development. With the passage of time, however, the objectives have become diffused rather than clear. Consequently, the CSIR has suffered from a crisis of identity which has become more and more pronounced. What is worse, there is a lack of focus and direction in the work of the CSIR.

1.7 Second, the present scale of operations of the CSIR is sub-optimal, as a consequence of which it does not reach the critical minimum. This is so for two reasons. First, the resources provided to the CSIR system are small in magnitude, whether total or per scientist, when compared with defence research, atomic energy or space. Second, the limited resources that are available to the CSIR are fragmented in use, across an unmanageable number of projects and a large number of laboratories.

1.8 Third, sustained and meaningful interaction between the CSIR and its actual or potential users has been far from adequate. It appears to us that the scientific world of the CSIR laboratories has

developed in parallel with, if not in isolation from, the industrial sector in India. At the time the CSIR was born, the manufacturing sector of the economy was also an infant. Both grew up in a world of their own so that the interaction between scientific research, technological development and industrial production was not consciously nurtured. Over time, the laboratories in the CSIR and the firms in the corporate sector have come to acquire distorted images of each other. In caricature form, the industrial sector believes that the CSIR laboratories are incapable of useful and timely research, while the CSIR system believes that manufacturing firms, which have no capacity for technology absorption and development, always prefer the soft option of importing proven technologies. The interaction of the CSIR with the Government and the Universities is better but far from satisfactory.

1.9 Fourth, the culture of work in the CSIR, as in many other institutions in our society, has two distinct attributes. There is little reward for performance and there is no penalty for non-performance. There is, hence, an accumulation of scientists past their prime which is reflected in the rising age composition and the near absence of mobility. These problems are compounded by the fact that the CSIR functions like a department of the Government rather than as a society. This has tended to foster hierarchy or bureaucracy and stifle creativity. It is ironic that the culture of the Government has become dominant while the culture of science has become subordinate in the CSIR.

1.10 Fifth, the CSIR does not perceive or recognise itself as a corporate entity which has a unified set of objectives. It is loose confederation of laboratories, each of which has its own divisions and disciplines. These constituents of the CSIR do not work in tandem even if they do not function at cross purposes. In this milieu, it is hardly surprising that the CSIR is characterised by a pursuit of objectives which seeks recognition for individuals rather than successes based on team work.

1.11 Sixth, the composition and the quality of output from the CSIR leaves something to be desired. There is a disproportionate

emphasis on basic research, not always well chosen, which can bring recognition from other scientists in the profession; as a corollary, applied research in the sphere of development of technology is mostly neglected, *inter alia*, because it is riskier and yields little in the form of academic kudos or material rewards. Even in the realm of basic research, however, international standards of excellence have been attained only in exceptional cases.

1.12 To a significant extent, the problems outlined above are endogenous to the CSIR system in so far as they are attributable to factors within its control. It must be recognised, however, that some of the problems are exogenous to the CSIR system and solutions are beyond its reach. This is hardly surprising in a context where the CSIR system is only a part of a much larger whole. The environment within which CSIR functions is clearly an important determinant of its success in the realisation of stipulated objectives. Hence, the blame for what has gone wrong cannot be laid at the door of the CSIR alone. It is as much a failure of the other two major actors on the stage: the industrial sector which did not seek to utilise the talents of the CSIR, and the Government which did not create a framework of policies that would have been conducive to this interaction. The reasons are interactive and the responsibility is collective.

1.13 The problems that have arisen are obviously specific to the context of our situation, but the nature of the dilemma is by no means unique. At earlier points in time, other countries arrived at a similar conjuncture, and many of them chose to abandon a centralised system for scientific and industrial research to integrate the scientific work into universities and applied research into R&D in the industrial sector. It is our considered view that a similar course of action would not be advisable at our present stage of industrialisation and development, as it would be premature. The levels of technology consciousness and technology development in our economy also remain low. Given the importance of externalities which lead to a divergence between the social and the private evaluation of costs and benefits, the CSIR has a role to perform in the development of technology for industrialisation in the short and

medium term. In the long run, however, we believe that the natural home of scientific research is in the universities, just as the natural place for industrial R&D is in the manufacturing enterprises. The ultimate role of the CSIR system in such a world would be in the sphere of scientific frontiers and high-impact technologies, where the prime objective would be social benefit rather than private profit. That, in turn, would mean a radical transformation of the CSIR. But the period of transition cannot be short. The universities system would have to strengthen and grow in terms of excellence, while the industrial sector would have to come-of-age in terms of its ability to absorb and develop technology through R&D within firms.

1.14 For the realisation of our national objectives in the medium term, in the sphere of science and technology, we have recommended changes in the objectives, the structure and the functions of the CSIR. We have suggested mechanisms whereby the CSIR would interact with its potential users. We have also set out a framework of policies which would be conducive in interaction between scientific research, technology development and industrial production. All these are necessary. But, by themselves they cannot be sufficient. At a macro level, we would also like to stress the strategic role of the Government which goes beyond policies, in terms of both guidance and support, in planning for technology development and structural change in the industrial sector.

DIRECTION AND FOCUS

Programmes and Priorities

1.15 It is imperative to provide the CSIR with a sense of direction and a clarity in objectives. For this purpose, we have defined the following areas of activity for the CSIR system:

(i) *Technology Missions:* In sectors such as steel, fertilisers, petrochemicals, energy and transportation, where we have planned large investments, there are a number of problems requiring S&T solutions which necessarily have to come from indigenous sources. A second set of missions would be in sectors where technology is closely held

or captive, so that independent development of technology would improve our bargaining position and maintain our competitiveness; in such areas, technology development cannot be carried out in its place of use. A third set would be technology application missions which would involve the acquisation of known and proven technology and its introduction in key sectors. These missions should have clearly defined objectives and specified parameters in terms of time, cost and performance. The task of leading and coordinating such missions should be assigned to the CSIR system.

(ii) *Technology Programmes:* The CSIR would have to assess and master selected advanced technologies, mainly of a generic nature, in areas such as microelectronics, material sciences, instrumentation, telematics and genetic engineering, where technical progress is rapid, the rate of obsolescence is high or the future implications are far-reaching, and where we are new entrants. The technologies in these areas are neither firm-specific nor industry-specific. The CSIR should have pivotal role in the assessment, the acquisition, the absorption, and the ultimate development of such technologies.

(iii) *Sponsored Research:* To solve problems for individual firms or specific industries, sponsored research should be undertaken in the CSIR laboratories. This would require matching the needs of the users with the capabilities of the doers. There should be an emphasis on problem-solving by interdisciplinary teams and, in some areas, research may well be sponsored by a consortium of firms in a cluster of CSIR laboratories. This would also facilitate further interaction between the CSIR system and the industrial sector.

(iv) *Basic Research:* A clear divide between basic research and applied research is neither feasible not desirable, for each forms an integral part of the other. Nevertheless, we believe that the natural habitat of basic research is in the Universities and it is necessary to correct the present imbalance of emphasis in the CSIR. In general, therefore, its laboratories should not devote more than 25% of their time and resources to basic research, but this norm should not be inflexible for areas where we are in search of excellence or in areas where we do not have the talent. Needless to add, the CSIR

system should not confine itself to needs and the concerns of the present or the immediate future alone. It is also necessary to encourage exploratory research with a futuristic perspective.

(v) *Societal Missions:* There is now a recognition that technology can make a positive contribution to the solution of societal problems such as water, public health and environment. While the CSIR can provide only one input in a much larger effort, it should have a defined programme to bring together some of its laboratories and scientists into close interaction with the concerned agencies. The collaborative role of the CSIR in this task would also enhance the social relevance of the scientific research.

Functional Focus

1.16 The specification of programmes and priorities needs to be combined with a functional focus, for the CSIR must concentrate by limiting the breadth and extending the depth of its activities. In our judgement, the work of the CSIR would acquire the sharp focus that it needs through directed missions or programmes and contractual sponsored research. We suggest that, by the end of the Seventh Plan, the CSIR must finance atleast one-third of its expenditure through sponsored research. This compulsion to earn its keep would obviously impart a clear sense of direction. In pursuit of the same objective, we have also recommended that each of the CSIR laboratories must narrow its focus to at most three areas of specialisation, which would be chosen in accordance with its strength; other activities or work would either be transferred to another laboratory or simply discontinued.

Interaction With Users

1.17 Apart from the basic research and the exploratory research the other activities proposed for the CSIR are, by definition, based on a user-identification. This constitutes an essential first step towards creating institutional mechanism which would facilitate interaction between the CSIR system and its potential users. It is inevitable that the nature and the form of interaction would not be the same for the private sector, the public sector and the governmental system.

(i) The sponsored research in the CSIR laboratories contracted by the private sector would, by its very nature, guarantee interaction with potential users. After all, those who provide the resources are bound to monitor their effective use. However, the linkages would have to go beyond a customer-contractor relationship, to institutionalise the interaction on a broader basis, through exchange of personnel, sharing of equipment, collaborative projects, consultancy arrangements and so on. In sum, points of convergence would have to be established so that the CSIR and the industrial sector work together. It must be recognised, however, that the interaction between the laboratory and the factory cannot be left to the CSIR and industry in the market place alone. At present stage of our industrialisation, it is imperative that the visible hand of the State provides a guiding role.

(ii) We believe that there should be a particularly close interaction between the CSIR system and public sector undertakings, which goes beyond the linkages implicit in sponsored research. For this purpose, CSIR personnel from the appropriate laboratories should be associated with the acquisition of imported technology by public sector undertakings, right from the beginning, for a participative and interactive role in the early stages of absorption, and then be provided with an opportunity for technological upgradation and innovation. The process of consultation between the CSIR and the public sector in the matter of technological choice and development should be continuous, and this would be facilitated by the presence of eminent CSIR scientists on the Boards of Directors.

(iii) The technology missions, the technology programmes and the societal missions constitute directed research which would be financed and monitored by the Government through CSIR Headquarters, and this would provide the basis for interaction. However, the linkages between the Government and CSIR system must transcend this rudimentary level. For one thing, the Government must interact with the CSIR in its planning for technology development. For another, there exists in the governmental system an extensive network of scientific research, outside the CSIR, in the realm of defence research, atomic energy and space; it is now time to coordinate the

activities of the CSIR with the activities of these other organisations, so as to avoid duplication, exploit comparative advantage and promote collaborative work.

Finance

1.18 In view of our perception that the resources provided to the CSIR have not been sufficient for a critical minimum, finance, and the terms on which it is made available, constitutes an important element of our solution. Clearly, the resources to fund the directed missions and programmes have to be provided by the exchequer, just as the finance for the basic research and the exploratory research has to be provided by the Government; the sponsored research, of course, would be paid for by those who commission it. We would like to make four specific recommendations in this context. First, the finance for Technology Missions, Technology Programmes and Societal Missions should be provided for the entire duration of each mission or programme on a multi-year basis, rather than as an annual allocation. Second, the finance for basic research should be provided for a two-year period which coincides with the peer review of such work. Third, the budget allocations in the CSIR system should be based on programmes and projects rather than the present division of scarce resources among laboratories. Last, but not least, the earnings of the CSIR from sponsored research, which should reach at least one third of the total expenditure in the CSIR by the end of the Seventh Plan, should not accrue to the consolidated fund of India, but should be retained within the CSIR.

REFORMING THE CSIR

Consolidation and Re-structuring

1.19 The limited resources available to the CSIR are fragmented in use across a large number of laboratories and too many projects. In our judgement, most of the constituent units of the CSIR and the system as a whole exceed their optimal size. It is now time for consolidation rather than expansion. For this purpose, the spread of the CSIR system should be reduced to manageable proportions. As

the most important step in this direction, we would recommend that the number of laboratories and institutions in the CSIR should be reduced through closures, transfers and mergers.

(i) *Closures:* Among the laboratories, RRL Bhopal has not yet evolved to a minimum threshold in terms of scientific manpower, infrastructure and, above all, direction or specialisation. The CSIR should explore the possibility of the State Government taking over this laboratory, and if that is not possible, it should be closed; the staff would have the option of returning to the CSIR. Apart from the laboratories, the CSIR also has almost 100 field centres which are spread nation-wide. The latter have not served any real purpose. We recommend that the CSIR divest itself of all such field centres by the end of the Seventh Plan. There should be an effort to see whether these field centres can be taken over for any effective use by public sector enterprises, State Governments or local authorities, with Central Government assistance for a limited period. Wherever this is not possible, the field centres should be closed down and their staff absorbed in the CSIR system.

(ii) *Transfers:* In situations where new scientific departments have been recently created, with a focus and a culture that is scientific rather than departmental, and where there are CSIR laboratories specialising in precisely the same areas, vertical integration of such laboratories with the concerned department would be scientifically and technologically more beneficial than the horizontal linkage with the CSIR. Thus we recommend the transfer of: (i) the National Institute of Oceanography to the Department of Ocean Development, (ii) the Institute of Microbial Technology and the Centre for Cellular and Molecular Biology to the Department of Biotechnology, and (iii) the National Environmental Engineering Research Institute to the Department of Environment. We would like to stress that the autonomy and independence of these transferred laboratories must be preserved through an appropriate society-structure like that of the CSIR. It is our view that the National Institute of Science, Technology and Development Studies should be transferred to the Department of Science and Technology which should have the nodal responsibility for S&T planning across the spectrum of scientific agencies in the country.

(iii) *Mergers:* The Publication and Information Directorate and the Indian National Scientific Documentation Centre should be merged to provide a consolidated information system.

1.20 The Regional Research Laboratories are characterised by a multiplicity of objectives, a proliferation of projects and a diffusion of activities. While their aim of serving the region has been realised to a limited extent, the fragmentation of resources in use has kept them from the critical minimum. It is now time for re-alignment and focus. The Committee believes that it would be more meaningful if these laboratories are given a new character and re-named to provide a clear orientation and unified directions: (i) RRL, Bhubaneswar as 'Central Minerals Processing Laboratory'; (ii) RRL, Hyderabad as 'Central Institute of Chemical Technology; (iii) RRL, Trivandrum as 'Central Plantation Products Laboratory'; (iv) RRL, Jammu as 'Central Laboratory for Natural Products'; (v) RRL, Jorhat as 'Central Laboratory of Agri-Products and Agri-Chemicals'.

1.21 The management of CSIR system is also difficult because of the very large number of projects and the size of the staff. There must be a drastic reduction in the number of projects which are at present in the range of 1300. Over time, the ratio of scientific to non-scientific personnel in the CSIR should be changed from its present level of 1:3 to 1:1.5. There is need to trim the non-scientific overheads.

Laboratories

1.22 To a significant extent, the solution to the problems of the CSIR must be found at the level of the laboratories which constitute the system. While a few laboratories have a well defined set of tasks, others lack cohesion, focus and direction in their work. To remedy the situation, it is necessary to improve the management of the system through a clear conception of the work programme and a systematic review of its progress. The present Research Advisory Councils, which have not been effective, should be reconstituted as much more compact Research Councils, with a smaller number of members with professional expertise who are involved in

the programmes of laboratories in an interactive manner. The performance of the laboratory would be reviewed every year by the Director-General of the CSIR in consultation with the Research Council. For the basic research carried out in the laboratory, there should be a peer review every two years.

1.23 For a better management of the laboratory, we would suggest that the present Executive Committee be replaced by a Management Council, the membership of which would be entirely internal and the functions of which would be only administrative. The Directors of laboratories should concentrate their energies on providing scientific leadership and must phase themselves out of the administrative role; such a transition would be facilitated if there is a deputy with the necessary administrative skills and experience.

1.24 The accountability on the part of the laboratories, in terms of their work, is absolutely necessary. It needs to be matched with an increase in their autonomy. We recommend that the laboratories should be delinked from the routine administrative and financial control of the CSIR Headquarters and, except for a few subjects that have been specified, the laboratories would not be dependant on the Headquarters for decisions. Such decentralisation is a new step.

Headquarters

1.25 At present, the functions of the CSIR Headquarters are largely administrative rather than scientific, which is not as it should be. We believe that the Headquarters should be the nerve centre of the CSIR system and not its administrative muscle. Its principal task should be to plan for scientific research and technology development for which purpose it needs more horizontal liaison outside CSIR and less vertical control within CSIR. Towards that end, it should engage in a continuous dialogue with departments in the government as also its potential users in the industrial sector. It should pay particular attention to the mobilisation of resources to finance its missions, for which purpose it needs to interact with the User-Ministries, the Planning Commission and the Ministry of Finance. It should have

a planning group that serves as a think tank on science and technology and, at the same time, considers the impact of economic policies.

1.26 For such a re-orientatin in the Headquarters, we recommend two steps. First, there should be a change in the composition and the role of the Governing Body. Its Chairman should be a distinguished person from outside the CSIR, while the Director General should be a Member. We have suggested that there should be many more external members drawn from eminent industrialists, technologists, scientists, design engineers and economists. In our view, the Governing Body should relinquish its role in routine administrative matters and perform its role in planning the future and formulating policy guidelines for the CSIR. Second, the structure of the Headquarters must match its functions. Once the present functions of financial and administrative control over the laboratories are discontinued, the Headquarters would need an infrastructure for its new role. To meet this, we recommend that there should be a Research and Planning Group, a Technology Development Group and a Human Resources Development Group in the Headquarters which would assist the Director General. Each of these three Groups would be headed by a Chairman; while the Groups would be permanent, the Chairman and Members, to be drawn from the CSIR system, would be in place for a specified period.

Personnel

1.27 We are convinced that, in the ultimate analysis, the quality of persons will determine the quality of work in the CSIR. For this reason, among others, personnel policies are crucial. To begin with there must be a judicious blend of individual effort and group activity; similarly, there has to be a conscious shift in favour of technology development work and the reward system should reflect this philosophy. At the apex of the pyramid, we would like to stress that the Director General of the CSIR and the Directors of its laboratories must be selected on the basis of their scientific eminence and leadership qualities. It is the combination of professional excellence and proven track-records that matters and not longevity in service. The

appointment of the Directors of laboratories, as also the Director General of the CSIR, should be for one non-renewable term of six years. Even well-chosen leaders need talented and motivated teams; the recruitment of young scientists into the CSIR system should be based on standards of excellence. However, problems arise later if we cannot reward performance and penalise incompetence.

1.28 We recognise that approbation is often a more important reward than a material incentive for most scientists. Nevertheless, we would suggest a separate parallel track of appointments where young and promising, or established eminent scientists can be recruited on contract, for a period of six years, at salaries which are 50 per cent higher than the usual. It is hoped that this experiment would attract new talent into the CSIR, and reward existing scientists in the CSIR system who are willing to give up security of tenure for this new track. The solution to the problem of non-performance, however, is not simple because we cannot expect our scientists to be immune from the usual pressures of society. All the same, it should be possible to provide at least a partial solution by offering generous terms of superannuation, to those who have reached the end of their creativity as scientists.

1.29 The near absence of mobility and the rising average age of scientists in the CSIR are two important manifestations of the personnel problem which must also be addressed. We have suggested some mechanisms and incentives which would facilitate the mobility of scientists from the CSIR system vis-a-vis Universities, public sector undertakings, and private sector firms. In the long run, this would make interaction between the CSIR and its users both meaningful and sustainable.

1.30 Last, but not the least, there is an important dimension of human resource development, training which requires far more attention in the CSIR system. We would recommend that the CSIR should establish a Central Training Institute which would provide: (i) training to the young scientists recruited by the CSIR to give them a wider exposure beyond their discipline and laboratory;

(ii) exposure to scientists at later stages of their career development; and (iii) training in the management of science along with an exposure to the wider world of economy and society.

THE WIDER CONTEXT

The Policy Framework

1.31 It is our considered view that an integrated set of fiscal policies, industrial policies and trade policies should provide a judicious blend of carrot and stick which would accelerate the absorption of imported technology, foster the development of indigenous technology and create an environment which would be conducive to innovation. In particular, the policy framework should seek to stimulate the supply of, and create the demand for, indigenous technology. In the pursuit of this objective, the guidance, the support and the commitment of the Government, which goes beyond the creation of a framework of policies, is essential. State intervention at the macro level would increase the impact of economic policies at the micro level.

1.32 In order to stimulate the supply of indigenous technology, it is necessary to encourage R&D expenditure within firms and the sponsorship of industrial research at the CSIR as well as Universities. For this purpose, the Government should impose a cess of 0.75 per cent on the ex-factory value of output, for every firm, from which the actual R&D expenditure incurred by the firm *and* 133.33 per cent of the amount provided to sponsored research in the CSIR system or in Universities, would be deductible. At the same time, to create a demand for indigenous technology, the policy regime should reward any firm that uses and commercialises indigenous technology, through the benefit of accelerated or, if possible, free depreciation, the provision of venture capital for pilot plants, resources for design engineering and soft loans for investment in commercial production.

1.33 In order to facilitate the absorption of imported technologies, we have recommended that for every rupee paid as royalities, technical fees and lumpsum payments, per annum, for the import of

technology, the firm must spend at least one rupee on in-house R&D to be directed towards absorption of that technology; if the actual R&D expenditure falls short of this minimum, the firm would have to pay the difference as a fiscal levy to the Government. In the public sector, as suggested earlier, the role of the CSIR in technology absorption and development can and should be more active. Similarly, in the private sector, where payments on account of import of technology exceed a minimum threshold, it is essential to create a mechanism which would ensure absorption of the imported technology within the firm and, subsequently, facilitate its further development and horizontal diffusion outside the firm.

Ethos of the System

1.34 We have recommended changes in the objectives, the functions and the structure of the CSIR, which should enable it to make its expected contribution in the sphere of scientific research and technological development. But this would not be enough. There has to be a change in the ethos of the CSIR system without which no reform can suffice. The importance of this cannot be stressed enough for many of the changes that we have proposed. For example: the CSIR should function as a society and not like a department of the Government; the CSIR should recognise itself as a corporate entity with a unified set of objectives; the CSIR should develop a consciousness about marketing its output; there should be a reward for performance and a penalty for non-performance; there should be a much greater mobility of scientists from the CSIR system; there should not be any curbs on the creativity of young scientist; or, the emphasis must shift from the pursuit of excellence in basic research for the individual to the collective objective of applied research based on team work. The organisational and institutional restructuring of the CSIR, even if it is combined with compulsion, cannot ensure the realization of these objectives. There has to be a change in perceptions, motivations, attitudes and, above all, the culture of work, which, taken together, add up to the ethos of the CSIR system.

Role of the State

1.35 In conclusion, we would like to stress that the CSIR is only one part of a much larger system. Apart from the reform of the CSIR, therefore, we have outlined a framework of policies which would be conducive to interaction between scientific research, technology development and industrial production. We have also suggested mechanisms which would facilitate interaction between the CSIR and its actual or potential users. This larger package of policies is necessary but not sufficient. Technology is too complex and important a matter to be left to the scientific community and the corporate sector in the pious hope that they would interact through the market mechanism and deliver the goods. In the realm of technology, the role of the Government is strategic at a macro level. There must be a vision, if not a grand design, which would chart the sectoral-mix and the temporal-sequence of technological development. This means planning for the acquisition of the technology where it is to be imported, setting resources for the development of technology where it is to be produced at home, or even deciding to opt out of a technology where it is not needed. These perceptions and judgements can be derived only from a continuous interaction between the Government, the industrial sector and the community of scientists-engineers-technologists. The guiding and supportive role of the Government has indeed been at the foundations of technological development among the late industrialisers. Such an approach, it need hardly be stressed, calls for more, not less, State intervention, but the nature and the quality of this intervention has to change.

2 PERFORMANCE OF CSIR

WHAT CSIR HAS DONE

2.1 The CSIR was constituted as an autonomous society in 1942. The charter of objectives of CSIR enunciated then and unchanged till today is all-encompassing. This includes promotion, guidance and coordination of scientific and industrial research, collection and dissemination of information on research and industry, founding of laboratories to further scientific and industrial research and exploitation of the research results for development of industry. CSIR was also charged with other tasks such as rendering assistance to other institutions conducting research, awarding fellowships and publishing scientific journals.

2.2 CSIR has set up an extensive network of 39 research laboratories with over 100 extension centres and regional stations spread throughout the country. These laboratories cover a wide range of R&D activity - ranging from micro-electronics to metallurgy; medicinal plants to industrial machinery; chemicals to molecular biology. CSIR's expertise and experience is embodied in about 5,600 active scientists and technologists, supported by over 12,000 technical personnel, employed in an infrastructure built over the years at a cost of approximately Rs. 1,000 crore. The present annual budget of CSIR is around Rs. 170 crore.

2.3 CSIR has served as a spring board for scientific and technological activity in a wide variety of areas. It has spawned many organisations, many disciplines and most importantly has served as a nursery and training ground for many of the talented scientists and technologists in the country. Many of its contributions are intangible, but these very intangibles create an environment in which tangibles can be and have been delivered by others.

2.4 In some areas of basic sciences, CSIR has established centres of excellence for example in geophysics, radiophysics, catalysis and modern biology, that are internationally respected. In a few areas

CSIR has been well ahead of its time. CSIR laboratories, over 10 to 15 years ago, initiated work in the areas now considered 'frontier' such as semiconductor materials, solar energy and wind energy. Unfortunately, no thrust was provided and the work was not taken to its logical conclusion.

2.5 CSIR's scientific profile is impressive. It has the largest stock of S&T manpower and the largest number of Doctorates among all the S&T Agencies in the country. CSIR's performance in science has received adequate recognition. In terms of publications in foreign journals CSIR ranks second next only to the publications by the scientists in the University system. Even in terms of membership of national academies CSIR ranked third after the University and ICAR Groups.

2.6 Even measured in terms of tangible returns CSIR's performance has been significant, for example :

(i) Industrial production based on technology licensed by CSIR is presently around Rs. 500 crore. The annual addition to this ranges between Rs. 50 to 100 crore.

(ii) Over 50,000 wholly indigenous tractors valued at over Rs.200 crore have been manufactured based on CSIR knowhow.

(iii) Petroleum refining processes and novel catalysts developed by CSIR in association with consulting engineering design organisations and industry have enabled India to emerge as one of the few major technology licensors in the world in this high tech field.

(iv) A whole range of modern pesticides with low residual effects developed by the chemical group of CSIR laboratories are being successfully manufactured by a number of private sector units.

(v) CSIR-developed, world class, , Titanium Substrate Insoluble Anodes, are increasingly being used in the chlor-alkali industry. They help to save over 15% in electric power consumption.

(vi) The productivity in a number of sugar mills has been significantly enhanced by the use of instrumentation systems developed in CSIR.

(vii) Appropriate leather processing techniques developed and popularised by CSIR have enabled India to emerge as an exporter of value-added finished goods.

(viii) High level capabilities in CSIR for testing and design of aircraft have enabled safety evaluation and enhancement in the operational life of aircraft.

2.7 All these technologies have been successfully deployed. The lessons we draw from these successes are as follows :

(i) There has to be a close coupling between the CSIR laboratory, engineering design organisation and a manufacturing enterprise. It is only such a tripartite arrangement that would lead to successful commercialisation of know-how.

(ii) Success depends critically on the ability of the technology receiver to carry out improvements on his own. Since CSIR does not offer a complete technology package, the ability of the recipient would, to a large extent, determine success. Hence, greater the managerial, financial and technological resources at the command of the user of technology, the more likely the commercialisation.

(iii) Success has also ensued when the development team from the laboratory has moved out to manage the commercialisation of the knowhow developed by them. This ensures sustained commitment since self-prestige and credibility are at stake.

(iv) Success also depends on pressures of demand, and stimulation provided by the national leadership. When tasks have been specific and clearly defined, CSIR has been able to deliver the goods in the stipulated time.

2.8 It is essential that the following pages are seen in this background. Achievements are clearly there, but the potential is greater. The country would stand to gain if the CSIR system is properly harnessed.

WHAT CSIR HAS NOT BEEN ABLE TO DO

2.9 In the years immediately after Independence when CSIR set up national laboratories, the bulk of scientists and the scientific leadership of the organisation was drawn from academic institutions. This set a tradition which is an extension of the atmosphere of a university research department. This tradition dominates the culture of CSIR even today. Scientific investigations and research have become the major activities of CSIR, while development and engineering which are technological activities related to industrial exploitation of scientific results have taken a back seat. Except for a few laboratories, the interaction between the CSIR and industry is not to the extent needed. The natural tendency of the system to work in isolation has been reinforced by a bibliometric reward system that puts a premiun on individual excellence in science and is not conducive to team-effort where scientists come together to take up time bound projects of an applied nature.

2.10 In the 1950s and 1960s, a large number of laboratories were set up as part of the organisations of Atomic Energy, Space, and Defence Research. These laboratories were established with specific charters to help meet the science and technology goals of their parent departments. Thus, they began with the great advantage of being an inseparable part of a vertically integrated system. In other words, the innovation chain from research to production is complete in a single agency. Besides, their activities encompassed many high-tech areas such as high-energy physics, nuclear science, professional electronics, space science and flight technology, chemistry

of propulsion, and high-strength alloys, and so on. These laboratories were built around young men of excellence who in turn attracted much of talent that would otherwise have gone to the CSIR system. Opportunities were thus lost for CSIR laboratories to take the lead in emerging and exciting areas of science and technology. CSIR laboratories began to play a secondary role in these areas. Their role was confined to R&D in specific- areas or to undertaking testing and carrying out simulation studies. When confronted with these challenges, CSIR was not able to carve out a niche for itself on the basis of which a clear organisational focus could be provided to the system. Looking at the distribution of scientists in the CSIR system, 50% of scientist positions are in laboratories which were set up more than three decades ago.

2.11 On the educational front, with the expansion of university education, the teaching load on faculty in universities increased to such an extent that very few of them could take time off to carry out serious research. With the establishment of the Institutes of Technology, Universities were deprived of better talent in most of the engineering disciplines as well as being starved of equipment and facilities. A gap was thus created in many areas of engineering sciences as far as high quality research was concerned in the advanced institutes of learning with the exception of the Institutes of Technology, and the Indian Institute of Science. CSIR laboratories thus became, in effect post-graduate centres in the fields of Chemistry, Classical Physics, Biology, Civil and Structural Engineering and so on.

2.12 Under such circumstances, the original objectives pertaining to technology and development were relegated to the background. Whatever little interaction CSIR had with industry led to further estrangement. CSIR knowhow offered for commercialisation by the National Research Development Corporation (NRDC), was often untried, not fully backed by detailed pilot plant and engineering studies when required, and not supported by adequate technical and marketing after-sales service by NRDC. The absence of interaction at the working as well as at the managerial level between the laboratory and the NRDC on the one hand and the user on the other led to a perception that neither CSIR nor NRDC were

willing to take on long-term commitments to make success of the know-how transfer and to share equal responsibility for the consequences of the venture. The resistance to accept CSIR know-how increased as the impression gained ground that what was being offered was half-baked. There were positive contributions, but these got completely overshadowed by the negative aspects that gained prominence as a result of problems and failures encountered with knowhow under operating conditions. It is important to recognise that other scientific agencies bypassed the NRDC totally and have been able to establish direct communication and contact with users.

2.13 Thus, it will be seen that the past three decades have been trying times for the CSIR. A part of this could, no doubt be attributed to the policy environment which was not conducive to the development of indigenous technology in the civilian sector. However, the CSIR itself has had no, well defined, corporate goal or objectives. Planning and programming for research has been virtually absent. Project management systems have not been adequately established and an integrated approach to problem-identification, and problem-solving is not in strong evidence for all laboratories. Thus, whatever resources have been provided to CSIR have really not been optimally deployed. Of all the S&T systems, CSIR has given the maximum autonomy and freedom to its constituent laboratories to define their own programmes. This has led to a situation where each laboratory has tried to take on tasks that could better be performed by others. There are much fewer inter-laboratory projects in CSIR than in other technological organisations. Thus, the CSIR has not been able to bring its collective strength to bear on the development of systems of technology in areas that would be congruent to national needs and priorities.

2.14 The very concept of CSIR has become a myth. When we are speaking of CSIR, we are not talking about the single entity, but about a loose grouping of 39 laboratories dealing with a wide variety of disciplines with very little commonality among them. This diverse group has very few areas of convergence. Moreover, planning for

having more areas of convergence has not taken place. While this may not matter in science and research; for technology and development, unless there is institutional focus on a specific mission, the smaller and diverse units will put forth sub-critical efforts in their respective areas. Thus, there is need to streamline the structure and make it trim so that direction can be provided to the future role of the CSIR.

2.15 The major asset of any scientific system is its human capital. While quantitatively impressive, it is a matter of concern that this stock of human capital in CSIR has been allowed to be denuded without being recharged. A distinct lack of training and mobility in the CSIR system has further compounded this problem. It has made it difficult to prune areas of work which have lost their relevance in respect of their scientific or national importance. Retraining and reorienting scientists who have years of experience in particular areas of work is quite a difficult task, especially when they are older and senior in the hierarchy.

2.16 These weaknesses have now to be overcome. There is a clear need for sharpening of focus, delineation of thrust areas, strengthening of planning capabilities at the Headquarters level, change in systems of personnel management, change in patterns of funding, and change in the overall policy environment which leads to an increased demand for service and talents of the CSIR system. These issues are the concern in the pages that follow.

3 PROGRAMMES, PROJECTS, FUNDS

PROGRAMMES

3.1 CSIR's present scale of operation is sub-optimal, as a result of which it does not reach the critical minimum. This is because (a) the resources provided to the CSIR system have been comparatively small given the range of its activities; and (b) these limited resources themselves have not been effectively deployed. During the Sixth Plan period the expenditure on CSIR was of the same order as Agricultural Research and Space Research but 20% lower than Atomic Energy Research and 35% lower than Defence Research. The Plan outlay provided for CSIR in the Seventh Plan, is about one-tenth for Defence Research, one-half of that envisaged for Space Research and is approximately that for Nuclear Research alone. However, it is not just the magnitude of resources; what is equally important is how these resources are utilised. The limited resources that are made available have been fragmented due to inadequate research planning and programming. CSIR has not endeavoured to concentrate its resources in a few selected major areas to derive the maximum benefits. As of April 1986, CSIR had over 1,000 ongoing projects, not one of these envisaged an outlay of the order of Rs. 10 crore; in contrast, DRDO has 16 such projects. By taking on what can only be termed as marginal projects and sub-tasks most of the time, CSIR has not been able to make a major impact.

3.2 CSIR laboratories have departed from the original purpose for which they were set up and to preserve institutional stability have tended to diversify. Thus, laboratories have tended to work on areas most amenable to expertise of individual or small group of scientists. We have come across areas, as for instance, in tissue culture, fermentation technology, material sciences and toxicology where a number of laboratories have mounted programmes independently. No effort has been made to integrate this work. What has happened is that breadth has been achieved, but at the expense of depth. This is so as the selection and monitoring of projects today is left purely to the laboratory.

3.3 We do not wish to strictly regiment or rigidly mandate S&T activity. What is being suggested is a focal emphasis for every CSIR laboratory. As a beginning, the charters of the laboratories should be redrafted to reflect the changed circumstances in which the CSIR system is expected to operate so as to make the charters less general, less open-ended and more pointed. The clearer and more specific a laboratory's tasks are, the better its performance will be.

3.4 CSIR should identify specific opportunity and thrust areas in S&T. These would not merely be a consolidation of the present programmes and strengths of the laboratories. These areas have to be arrived at by a proper assessment of alternatives of CSIR's potential to contribute to economic development, societal needs and international S&T leadership. CSIR should commission technology forecasting exercises in selected sectors from which the corporate thrust areas can be derived. A group of experts could then resolve a thrust area into its components and laboratories assigned specific areas for development of expertise and excellence. Each laboratory should not be assigned more than three areas for development of expertise and excellence. The laboratories would then ensure that at least 50% of their resources, both manpower and financial are deployed in its areas of excellence. This should be applicable by the end of the Seventh Plan.

AREAS OF CONCENTRATION

3.5 The following broad areas of concentration of activity for the CSIR system are suggested :

(i) Technology Missions and Generic Technologies

3.6 (a) *Technology Missions:* These impinge on the evolution of Indian Industry in selected areas of national importance, which are so basic that we cannot be mere recipients of technology from abroad. A beginning could be made in industries where large public investments are taking place like steel, fertilizers, petrochemicals, energy and transportation. In these sectors there are a number of development problems which require S&T solutions which necess-

arily have to come from indigenous sources. In such cases research should be taken up which cannot be carried out in their place of use. Some of the technological missions could be, for instance, the development of new routes to iron making, the development of technologies to utilise poor quality Indian coals more efficiently in power stations, the development of alternatives to liquid hydrocarbon fuels, the development of low-cost food and produce preservation techniques and so on. The role of the CSIR must be to look ahead 5 to 10 years and develop processes where the underlying science and engineering is already known but application has not yet been fully worked out or exploited. In most of these areas there is no need to re-invent the wheel.

3.7 In addition to a set of such technology development missions CSIR has a distinctive contribution to make in technology application missions where the focus is on the acquisition of known and proven technology and its rapid application and diffusion in key industries to reduce costs and enhance competitiveness. Although it was not set in a mission framework with clearly defined time, cost and performance objectives, CSIR has already taken an initiative in this area by preparing a report on the potential for the use of micro-processor-based systems in some traditional industries like sugar, textiles, and leather. Such reports should form the basis of definite investment plans in industry in a specified time frame.

3.8 Although technology mission relating to both application and development are not confined to the CSIR system alone, we feel that CSIR Headquarters should take the lead and coordinate the critical missions. The Planning Commission should then take the final responsibility for having these reports discussed and finalised. The project reports are not meant to be mere scientific reports but should cover mission control and management strategies with a clear and detailed articulation, down to the most minute level, of the mission's time, cost and performance objectives and how these would be monitored according to pre-set milestones. The report would pinpoint precisely specific responsibilities of the participating agencies and would identify a structure of management including the designation of a mission leader and a mission team. ISRO has

demonstrated that such an approach is possible. The important point is that all systems must be in place before the mission is launched and no loose ends must remain.

3.9 For CSIR to demonstrate its credentials as a major scientific agency, we suggest that it should take up and complete atleast three major technology missions over the next 5 years. These missions should be large enough to make a substantial impact, should involve many laboratories and should be such that they solve some real live problems being faced by industry or by the country. The DG, CSIR should put forward to the Planning Commission a concrete set of proposals in this regard. The DG should then take the responsibility of ensuring that he gets what he considers to be essential inputs and resources for the successful execution of these technological missions.

3.10 (b) *Generic Technologies:* As a matter of strategy, CSIR should assess and gain mastery over selected, advanced technologies mainly of a generic nature, where technical progress is rapid, the rate of obsolescence is high or the future implications are far reaching. These technologies would be of value to broad range of industries and be those for which individual firms would not be able to invest adequate resources. This approach should be combined with activities of a "public service" character, such as research on environmentally benign, energy-conserving or capital-saving technologies that are unlikely to be sponsored by industry.

3.11 An example of such generic technologies on which CSIR will have to concentrate is the whole area of materials science such as composites, non metallic glasses, electronic grade materials and ceramics. The emerging importance of material sciences and technology need hardly be stressed. Quite a few CSIR laboratories have been working in this area for some time but their efforts have been sub-critical. We feel that there should be a concentrated effort in bringing together the talents from different laboratories even by transfer of scientists. If necessary international collaboration can be sought in these areas with research institutes in the forefront of technological development. Other examples of such generic areas

include micro-electronics, instrumentation, telematics and genetic engineering.

(ii) Societal Missions

3.12 These are social missions that necessitate a significant S&T component to realise the objectives. In such missions, the science is proven but the scientific component has to be engineered and processes have to be evolved to reduce costs, improve quality and enhance reliability. The success of these missions would depend upon inputs from various sources of which CSIR is one. A few such missions have already been launched and CSIR's role identified in them. We see the potential for CSIR to take on a few more missions - such as production of cheap health-kits, development of low cost nutritious foods for children and so on. These need not be restricted to solving problems crying out for immediate attention. Anticipatory planning of appropriate responses for problems likely to arise in the course of our development and as the population approaches the 1 billion mark could be taken up as such missions. The primary responsibility for identifying and giving concrete shape to a further set of such societal missions must lie with the Planning Commission.

(iii) Sponsored Research

3.13 Such R&D work is undertaken at the instance of specific users with a view to tackle problems of interest to them. Sponsored research should not just be an exercise in routine testing, simulation and trouble-shooting, but should emphasise problem-solving and knowhow development by inter-disciplinary teams. While no mix between short and long term sponsored research can be suggested, in view of past experience we would recom nend that such research also have specific time and performance objectives.

3.14 So far, sponsored research by industry has been to an individual laboratory that does not necessitate networking or coming together of laboratories. Although this should continue, there is scope for consortium-based sponsored research. In some areas like micro-electronics, there is much to be gained from the cluster approach

both in regard to sponsors and in regard to the laboratories who would be involved. Such an approach would have the aim of long-term R&D to take the consortium of industries higher up the high-tech ladder and short-term R&D with emphasis on solving the problems of individual members of the consortium. CSIR Headquarters has to take on the role of bringing such consortia together.

(iv) Basic Scientific Research

3.15 This is intended to exploit innovative scientific opportunities and to establish the foundations for future technology development. In many areas considered 'frontier' today, some of the laboratories both in the CSIR system and in others had established competence and capability some years ago. Unfortunately, this could not be sustained because of the insistence on immediate returns. Many worthwhile scientific programmes have had to be jettisoned to accommodate shifting perceptions. CSIR has now to take on the responsibility not only for keeping abreast of the most recent developments but also of attaining a position of international leadership in some select areas of high science. It can even collaborate internationally. Besides, goal oriented basic research is an important input to applied research and technology development. Although no rigid formula can be prescribed, about 25% of CSIR's manpower and financial resources should be committed to this area.

CLASSIFICATION OF PROJECTS

3.16 Presently, projects are not classified according to the involvement of manpower and requirement of financial resources. The effort of an individual scientist working on a research project having a resource input of less than 1 lakh rupees and that of a major project involving several scientists envisaging an outlay of over 500 lakh rupees are both classified alike.

3.17 It is recommended that the classification of projects in the CSIR be on the following basis:

(i) Mission/Agency Projects

3.18 Projects that necessitate networking of inputs from several laboratories/organisations. The initiation of such projects as well as their integration, monitoring would be done centrally by the Headquarters. All mission projects would be actuated by users and would have the highest priority. Once a Mission Project has been finalised by Headquarters, the DG would establish a Project Mission with a clearly identified Project Coordinator and Project Monitoring Group. They would directly report to the DG.

(ii) Laboratory Projects

3.19 These would include projects that are initiated by the laboratory.in its area of expertise/excellence:

(a) with a specific objective or goal, and with user or potential user involvement; and

(b) basic research projects.

Laboratory projects would be initiated by the laboratory on approval by the Research Council. In the case of goal-oriented projects, project document including statement-of-the-art, preparedness of the laboratory to take up the work, technological approaches, resource inputs, milestones/time scheduling, cost-benefit evaluation, etc. would be prepared for the consideration of the Research Council. These would be prioritized and monitored by the Research Council. The basic research projects would be evaluated every two years through a peer review.

(iii) Exploratory Research

3.20 Exploratory projects basically aim at investigating potential of basic knowledge to specific application areas. These are in the nature of pre-feasibility studies and should not normally extend beyond one year. Exploratory projects would be initiated by the Group or Project Leaders. These would be approved and monitored by the Director and their progress reported to the Research Council.

FUNDING OF CSIR

3.21 Over the years CSIR, like other Government Agencies, had no pressure on it to seek external funding. The laboratories remained less responsive to the needs of the users. Although the State would need to continue to support the CSIR, a measure of their credibility with their clients is the funding they can obtain from the outside sources. We recommend that by the end of the Seventh Plan, CSIR should increase its external funding from the present level of about one-eighth to at least one-third of its total annual expenditure from outside the Central Government core grant. CSIR should be permitted to retain these earnings. It is to be emphasised that this should include not only contract research from Government Agencies but from Industry as well. The CSIR should internally decide on the level and programme of external funding for each laboratory. Public funding should flow into those R&D activities where the risk element is high and/or where there are larger number of potential beneficiaries.

3.22 Funding for problem-solving at the industry and enterprise level must come from the users themselves. For the missions, the Planning Commission should require deliberately setting apart some funds (say 1% of allocations) in the various Government Departments for such tasks with a directive that these funds be utilised exclusively for supporting mission-oriented and large technology-oriented tasks in R&D institutions that would include CSIR laboratories as well. This way, planning for science and technology will not be some nominal good faith investment in R&D in various agencies but will become an integral part of the planning process itself.

3.23 Most of the CSIR laboratories were established more than two decades ago. The pace of their modernisation has not been in step with rapid changes in S&T. This has been mainly due to budget constraints. CSIR cannot be expected to work on S&T of the 21st century with such wherewithals. Therefore a one-time grant of Rs. 100 crore be provided to the CSIR system for modernisation of its hardware which should be carried out in a phased manner over the next two years. This should be on a 'one-time' basis. CSIR would thereafter keep abreast by ploughing its earnings for continued modernisation of its hardware and through its budget.

3.24 The elements for adoption of the zero-based budgeting systems exist today in CSIR, however not many of the laboratories have adopted this system fully. We recommend that this be adopted by all the laboratories by the end of the Seventh Plan. It should be mandatory in all laboratories to adopt this technique of financial management. However, this must be based on the clear understanding that funding has to be on a multi-year and assured basis; for missions it should be over the mission period; for basic research, it could be over a two year period, coinciding with the frequency of the peer review; for other programmes it could be on an annual basis.

3.25 Pattern of funding apart, there has to be a sea-change in project management systems. Research efficiency, is determined to a considerable extent by the effectiveness of the practice of project budgeting, costing and accounting. This aspect of project management is yet to take root in the CSIR system. For instance, project costing is done only for sponsored projects. Despite the fact that almost all laboratories claim to have sound project budgeting systems in place, project costing is done only by four laboratories. CSIR and the laboratories continue to allocate resources on the basis of conventional subject heads. Resource allocation should be on the basis of programmes and projects instead of being on the basis of aggregates. We recommend that by the end of the Seventh Plan project budgeting, accounting and costing systems should be in place in all the laboratories.

4 INTERACTION WITH USERS AND UNIVERSITIES

4.1 Excellence in isolation can only lead to alienation and frustration. To avoid this in future,CSIR needs to establish symbiotic linkages with its external environment from which it derives sustenance and strength.

4.2 There are no shortcuts to establishing and sustaining interaction with users. It is a long-term process. It calls for changes in systems of problem identification, project management, personnel policy, and more importantly, in attitudes. But these alone would not suffice; clients themselves must also feel the pressure to couple with the CSIR.

The channels of CSIR's interaction would be with :

(i) Government departments and agencies through the technological and societal missions;

(ii) industries at a sectoral level through Industry Associations, Scientific Advisory Committees, Development Councils and DGTD;

(iii) individual firms through sponsored research and consultancy;

(iv) public sector units through joint funding and joint research programmes; and

(v) academic institutions through sub-contracting of research and through personnel exchanges.

4.3 The problems that confront and the new opportunities that are available to industry and laboratories should have brought them together. But collaboration between them has been limited. CSIR and industry continue to have distorted images of each other. Industry does not hold a high opinion of the capability of CSIR to deliver use-

ful and timely results; it is believed that the CSIR has been technologically overtaken by industry and investments based on CSIR technology would not to very fruitful. On the other hand, opinion in the CSIR system is that industry has little understanding of how research might relate to its growth and getting more out of its existing assets than in its craze for imported technology.

4.4 We believe that a change in perception is taking place. Over the past decade, R&D consciousness in industry has increased. About 1000 in-house R&D units have since been established. These units are spending almost three times the resources expended on the entire CSIR. At the same time, there is a growing realisation in the CSIR that industry is now better placed to accept its output, if it is offered as a contemporary, competitive and comprehensive package. The imperatives of the new economic policies pursued over the past two years have pushed industry to perceive technology as a key element for survival and growth. This would help to foster durable linkages between R&D and production.

4.5 Current linkages are based on networks of interpersonal relations. These need to be formalised. CSIR management must help in creating conditions for institutional relationships. Discussion on mutual problems and opportunities could be held in the framework of Laboratory–Industry Associations. Various forms of linkages could then be conceived of. These could be based on:

- contract research,
- consultancy assignments,
- joint research projects,
- loans of equipment and facilities,
- personnel exchanges.

It would be worthwhile for CSIR to undertake technology-scan activities to inform the industry of the technological developments and changes in the technology scenario.

Scientific Advisory Committees

4.6 Two administrative mechanisms already exist for bringing CSIR close to working on live problems faced by industry. The first is the

institution of Scientific Advisory Committees in various Ministries. The success of some CSIR laboratories like the Indian Institute of Petroleum and National Chemical Laboratory in linking up with users has been brought about, at least partly, by the role played by the Scientific Advisory Committee to the Department of Petroleum. It has served as a valuable forum for scientists, technologists, engineers and plant managers to get together and interact on a continuous basis. The newly constituted Scientific Advisory Committee to the Department of Steel has also taken keen interest in this direction. But, for the most part, such Committees have not been constituted in other Ministries and where they have been constituted they have lacked the thrust, direction and sustained support from the bureaucracy. In some cases, they have probably not even met and have been lying dormant. We suggest that such Committees in key Departments be activised with truly outstanding professionals as members.

Development Councils

4.7 The second administrative channel available for bringing CSIR closer to working on Industry level problems is the Directorate General of Technical Development (DGTD). Today, the link between CSIR and DGTD is almost wholly non-existent. Every important industry under the IDR Act is supposed to have a Development Council which is an industry-wide body that is expected, among other things, to provide a forum for the identification of technological gaps. These Development Councils, with exceptions, have not even been constituted, and where they have been set up, they rarely meet. DGTD which services these Councils and is meant to provide forward-looking technology inputs has itself become a regulatory outfit, spending more time on licensing functions rather than on truly developmental ones. We suggest that since DGTD occupies such a central position in our decision-making apparatus on matters relating to technology, its role should be made truly development oriented. Meanwhile, a beginning should be made to have officers from DGTD work in CSIR laboratories so that awareness of indigenous S&T capability increases among agencies dealing with import of technology.

Public Sector Enterprises

4.8 A few laboratories have good individual relationship with specific Public Sector Enterprises (PSEs). However this is not enough. The

CSIR as a system must develop formal institutional and established linkages with PSEs. There are many reasons for doing so. For their part the PSEs stand to gain by:

(i) access to high quality research, manpower and facilities;

(ii) assistance in technology evaluation, selection and unpackaging;

(iii) support in absorption and upgrading of technology; and

(iv) sharing of research risks.

In turn, CSIR would also benefit through exposure to real-world problems of industry and gaining "hands on" experience.

4.9 PSE-CSIR linkages are the easiest to establish because both are in the public domain. An effective way to establish meaningful linkages is through financial participation in and initiation of joint research programmes between PSEs and CSIR. This would lead to rationalisation of R&D programmes between PSEs and CSIR laboratories. CSIR should be given representation on the Board of Directors of concerned PSEs and the PSEs be represented on the Research Councils of the corresponding laboratories. The administrative Ministries and the PSEs should be encouraged to sponsor projects with laboratories.

University System

4.10 Equally important is the interaction with universities and educational institutions because on this will depend the quality of scientific manpower going into the CSIR system. The natural habitat for basic research is and should be the university. If basic research is funded at universities, not only does research get done but in addition, students get trained, facilities get upgraded, faculty and students get more support and hence better faculty and students are attracted to research. These students then are the inputs to the research system. With basic research funded in the national laboratories, research results may be obtained, but most of the educational dividends get lost.

4.11 There must be a clear policy of nurturing select universities into world-class centres of excellence in basic research which would, in turn, have a beneficial impact on the quality of output emanating from the CSIR. CSIR should be intimately involved in the formulation of research programmes in science in universities. Currently, CSIR spends about 5% of its total S&T outlay in Universities, which is the maximum among all S&T agencies. Almost, 80% of this is in the form of fellowships. While this is important it is also necessary to boost contract research programmes. By the end of the Seventh Plan, it is recommended that the 5% share be increased to 8%, with the additional 3% being for supporting contract research with Universities.

Technology Package

4.12 Interaction and marketing are inter-related issues. Better interaction with users would ensue if CSIR is able to create confidence and establish credibility. For this, laboratories must be selective in the processes they release for commercialisation and make sure when they offer know-how or a technology, it has been thoroughly assessed. It is not uncommon even now to find statements from CSIR about development of new technologies available for commercialisation, without any rigorous internal evaluation of the technology package. CSIR must make sure that know-how released has not only been tried out at the laboratory level, but also wherever possible or necessary in batch production and pilot plants. For major technologies, CSIR must offer a complete technology package, including commercial guarantees and after-sales service. To do this, there has to be an intimate association between the laboratory and a Consulting and Engineering Design Organisation (CEDO) who would really be the marketing agency for technology to the ultimate user. They would engineer the laboratory know-how to that scale which can be put into commercial operation.

NRDC

4.13 Historically, CSIR has depended on the National Research and Development Corporation (NRDC) for its marketing. Today, NRDC has the sole and absolute right to the unencumbered intellectual property produced by CSIR laboratories. There has been wide-spread criticism of the NRDC for the over-centralisation, slow and cumber-

some procedures and for its lack of vigour in following up available technological opportunities. NRDC licensees have emphasised that it is they who have approached the NRDC and not the other way round. Most succeessful cases of technology transfer, both within the CSIR system and those involving other scientific agencies, have not involved NRDC in any way. The very concept of an exclusive company to market CSIR technology is outmoded. It is recommended that NRDC's monopoly on know-how generated in CSIR laboratories should end and CSIR laboratories be free to license and commercialise technologies through whatever source they choose to. NRDC would then have to compete on an equal footing with others to bid for commercialising CSIR technology.

4.14 Considering that nearly 80% of NRDC's earnings is derived from CSIR assigned technology, it would then face some financial difficulties. Given the way NRDC has evolved it may have a useful role to play in technology upscaling and transfer for the small-scale sector. Instead of creating new organisations for this purpose, it would be preferable to use NRDC's existing expertise and experience in this area.

Technology Transfer

4.15 As most of the laboratory projects would have user involvement and be monitored by a committed Research Council, the problems of the technology transfer would be vastly mitigated in future. However, to minimise the impediments to successful transfer of technology and its commercialisation CSIR should ensure that:

(i) any unencumbered know-how developed be independently evaluated;

(ii) Consulting and Engineering Design Organisations be associated in the preparation and commercialisation of complete-technology packages;

(iii) wherever possible, the development team be encouraged to move to industry to assist in productionisation of the knowhow; and

(iv) sponsors of R&D be given a 5 to 7 years exclusivity period, from the date of completion of the project to commercialise the knowhow, provided they take concrete steps to implement the project. Pioneering units availing of select high-risk un-encumbered knowhow could be given upto 3 years exclusive period to commercialise the knowhow.

5 MANAGEMENT OF CSIR

5.1 CSIR was intended to function as an autonomous society. However, it has not taken advantage of this. Even as early as 1966 Homi Bhabha had pointed out that the opportunity of framing an administrative structure and rules and procedures appropriate for a scientific organisation which a society-type set up was intended to confer on the CSIR has been lost by the omnibus adoption of Government rules and regulations. Other scientific agencies like the DAE and ISRO have considerable flexibility and freedom of operation; for instance, Government orders do not automatically become applicable to them.

5.2 A society-type structure provides for a more flexible system of management. Therefore it is recommended that CSIR should exercise the autonomy available to it as a society and not run as a government department.

Governing Body (GB)

5.3 The first item on the agenda for restructuring the management of CSIR is its Governing Body. It is meant to be the apex policy making authority for the CSIR and it interacts at the level of the CSIR Headquarters. Over the years it has been largely internalised. Its concerns have been mainly with financial matters and less so with scientific and technological aspects of CSIR's functioning. Seldom has the Governing Body laid down policy guidelines on R&D programmes, or interacted with the Research Advisory Councils (RACs) of the laboratories.

5.4 It is strongly recommended that the Governing Body have external linkages in the form of membership from a cross section of users. Thus, its membership must include representatives from industry, both public and private sector, engineering design organisations, financial institutions, universities and other scientific agencies. The Chairman of the Governing Body should be an eminent professional from outside the CSIR system, having an overview of the S&T structure and the economy and with the necessary autho-

rity. Its term should be for a period of three years and it should concern itself only with the laying down policy guidelines for the functioning of the CSIR laboratories, appointing chairmen of the Research Councils (RCs) and in general, to interact with other Government departments to bring about an environment conducive to indigenous technology development and utilisation. The present day functions of the Governing Body as they relate to the shorter term issues of administration and management should be delegated to the DG of CSIR. In the scheme of things the Governing Body should become the apex policy making body for the entire CSIR system.

Coordination Councils (CCs)

5.5 Secondly, the concept of Coordination Councils has not proved useful. The Coordination Councils were established as a result of the reorganisation of the CSIR on the basis of the Sarkar Commission recommendations. In essence, the Coordination Councils envisaged a grouping of laboratories on the basis of similarity of scientific fields. The Councils were also accorded a distinct structural character in order to enable suitable representation of the laboratories on the GB through the involvement of the Chairmen of these Councils. Thus, a kind of rigidity was built into the very concept of these Councils. More importantly, the concept appeared almost anachronistic in a world where different sciences tend to merge together. It was pointed out that in some cases projects have been assigned by these Councils only to justify the existence of the Councils.

5.6 The Coordination Councils have not fulfilled to any significant extent the functions they were charged with. Besides, coordination for major mission projects would now be on a centralised basis and duplication would be avoided through clearly defined thrust areas of laboratories. Thus we see no role for the Coordination Councils and recommend that they be disbanded.

Research Councils (RCs)

5.7 Third, the present system of the Research Advisory Councils (RACs) needs to be restructured. In most cases the RACs are being

used more to ratify the programmes and priorities evolved by the laboratory or by its Director rather than assist them in independent project and programme selection. At best, the RAC has served as a sounding board for the programmes proposed in-house. The RACs have often gone along with the Director without exercising critical judgement.

5.8 On the other hand the RACs have a legitimate role to provide a thrust, suggest new areas of research and orient R&D programmes in desired direction, apart from serving as a professional vehicle for monitoring of resource allocation and their utilisation in each laboratory. While the Director of a laboratory has executive responsibilities and reports to the DG, he should also be accountable on matters relating to R&D activities to the RAC. To reflect the larger role being envisaged for the RAC, it should be more appropriately designated Research Council (RC). It would not be an advisory body any longer.

5.9 The RC must have the most outstanding and distinguished professionals in the area of specialisation of the laboratory. But it would be unrealistic to expect committed and sustained interest and top-flight advice from these professionals without their involvement in the programmes of the laboratory. To facilitate their interactive role the expert members would be simultaneously appointed as consultants. Each of these experts be paid an honorarium of Rs. 10,000 per year as compensation for the time and effort they would be expected to put in. The external members would thus have a dual function :

(i) as experts for a few programmes in their area of specialisation; and

(ii) as members of the RC, reviewing the totality of all laboratory programmes.

5.10 We would then recommend that the membership of the RC be:

(i) five outside experts including the Chairman;

(ii) Director of the laboratory; and

(iii) a senior scientist from another laboratory to be nominated by DG, CSIR.

5.11 Secretary to the RC would be nominated by the Director. The term of the RC would be for three years and it would meet at least twice a year. The experts would need to meet every three months or so and put in a total of 8 days in a year at the laboratory for their assignment. DG, CSIR should annually review the performance of the laboratory in consultation with the Chairman of the RC and the Director. The deliberations of the RC should be one of the important inputs to monitor the performance of the laboratory and in the planning process of CSIR. In the case of basic research programmes a peer review could be held every two years by scientists nominated by DG and their report submitted to him. If necessary the bye-laws of the CSIR should be ammended to provide for this.

Management Council (MC)

5.12 Finally the present day Executive Committee (EC) be replaced by an internal Management Council (MC) to more appropriately reflect its functions of overall management of the laboratory and its immediate external environment. External members in the present day EC seldom have any insight or interest in the problems relating to laboratory administration and management. The revamped MC's functions would be limited to administration and management of the affairs of the laboratory so as to support the R&D plan approved up by the RC. It would have the Director as Chairman and comprise four scientists representing the following scientific categories B,C,E,F & G, a Director or senior scientist from outside the laboratory nominated by the DG and Administrative and Finance officers of the laboratory. Membership of the scientists should be on the basis of seniority at each level, and would be by rotation. This is important because there is wide-spread dissatisfaction at the way the existing Executive Committee is functioning, particularly, among the young scientists. The secretary would be nominated by the Director. The term of the MC would be for a period of three years.

Headquarters-Laboratory Relationship

5.13 CSIR Headquarters has to play a more active and meaningful role in :

(i) programme management involving projects requiring inputs from more than one laboratory;

(ii) in liaising with Government departments and providing feedback on threats and opportunities to its constituent laboratories;

(iii) in ensuring horizontal integration of skills and resources not only as far as the CSIR system is concerned but also in relation to other scientific agencies so that a whole system of technology can be provided; and

(iv) in developing the human resources of the CSIR system.

5.14 The Headquarters should have only staff functions whereas the line functions be entrusted to the charge of laboratories. Many Directors indicated that the Headquarters had acquired over-riding powers in matters pertaining to the laboratories, so much so that it even interfered in the day-to-day management of the laboratory. We understand that due to its proximity with the Government set-up, it has imbibed its bureaucratic culture. We suggest that it should shed its controlling functions in terms of finance, recruitment and administration. Thus it may be desirable to delink laboratories further from routine administrative and financial control of the Headquarters.

5.15 Thus the laboratories will be linked to the Headquarters only for :

(i) receipt and disbursement of the funds from the Government;

(ii) appointment of the Director and Research Council members;

(iii) international and interagency scientific collaboration;

(iv) Research Fellowships and Training;

(v) liaison and interaction with major users and Government departments;

(vi) Data Bank of total CSIR R&D activities; and

(vii) construction activity.

Headquarters

5.16 In the years ahead, the flexibility and ability to manage technological change will determine the success of our mastery over modern technology. This implies a multidisciplinary approach to management. The Headquarters should not be staffed by a permanent set of people but those best suited for a particular job at the given point of time. The Headquarters should ensure cross-fertilisation of ideas and disciplines by capillarisation of talent from the laboratories.

5.17 The Headquarters must evolve into a top-flight, lean and trim think tank. A major change in the operation of the Headquarters is called for to make it the nerve centre of the laboratories instead of being a mere administrative muscle. Headquarters has to plan for internal integration and unification of CSIR and programme for the use of its collective strength. Headquarters would play an interventionist role in laboratory activities relating to technology and societal missions, while the role would be an interactive one in the case of activities related to sponsored research and science.

5.18 We thus suggest the restructuring of Headquarters with three strong technological groups, viz., Research and Planning Group, Technology Development Group and the Human Resources Development Group. Each Group be headed by a Chairman with status at par with the Director of a laboratory, for a three year tenure. We feel that there must not be too many tiers between the DG and the Directors of laboratories. We do not see the need for having an Additional Director General interposed between the DG and the Directors.

Research and Planning Group

5.19 Its functions would be:

(i) interact with Planning Commission, other agencies and departments to catalyze their development/economic plans to S&T plans;

(ii) evolve a strategy for resolving these plans as Mission Projects;

(iii) identify networking of laboratories/institutions and assign tasks;

(iv) commission technology forecasting exercises to identify new opportunity areas for CSIR;

(v) provide secretariat for monitoring technology and societal mission projects, and

(vi) International Scientific Collaboration and Research Schemes.

Technology Development Group

5.20 Its functions would be:

(i) interface between the research system and its users;

(ii) endeavour to arrange for technology upscaling and proving;

(iii) secure legal protection for and assist in contracting of CSIR know how;

(iv) market CSIR technology and secure business;

(v) interact with Industry Associations, Public Sector Enterprises, Consulting Engineering Design Organisations; and

(vi) maintain the Central Information System for CSIR.

Human Resources Development Group

5.21 The success of CSIR to face the challenges ahead with confidence would depend on how well the Human Resources Development Group functions. We envisage it be professionally strong with understanding and empathy for group activities. It shall perform the following functions;

(i) career development of staff including training, deputation of scientists in India and abroad;

(ii) external manpower development through Pool Placement, Research Fellowships and Associateships;

(iii) Administration and Finance. Codification of administrative and financial rules, instructions and procedures to be followed by the laboratories;

(iv) interaction with Government departments on matters of finance and administration; and

(v) science promotion.

6 PERSONNEL POLICY

ORIENTATION

6.1 We are now witnessing the graying of CSIR. There is a distinct middle age bulge in the organisation. The average age of scientists is well over 40. At the level of Scientist B - a level that accounts for about 50% of the total scientist strength in the CSIR system - the average age is as high as 38; considering the age structure of the laboratories themselves, this average should be a decade less. Intellectual capital has to be renewed and recharged.

6.2 CSIR has been a pioneer in introducing progressive promotional policies for its scientific staff. However, its scheme of promotion, based on assessment of merit, has in practice, operated as a common leveller treating the 'achievers' and 'non-achievers' alike. This has given rise to the feeling that good performance does not confer any additional benefits. The ideal policy would be one where there are no tenure appointments and continuance, and promotion in the system is based purely on performance evaluation.

6.3 There are three aspects of personnel policy that require to be changed if CSIR's orientation from research to technology and development has to be successfully effected. These are:

(i) encouraging development and team effort without totally de-emphasising individual initiative and research effort;

(ii) recognising the need to give importance to management of science and scientists at the middle and higher hierarchical level; and

(iii) increasing outward mobility so that it would be possible to induct fresh and young scientists in sufficient numbers without requiring unduly to increase the total number of scientists in the organisation.

6.4 Encouraging development work among the scientists requires that the organisation ammend its value/reward system. While publications by the scientists are important, it should be used as supplement to peer review system as is practised in some academic institutions such as Indian Institute of Science, Bangalore. While the time for appearance before the Assessment Board is determined on the basis of confidential reports of the scientist, his promotion is decided by the peers who are provided with a detailed report by the scientist of the jobs carried out by him during the period under review. The CSIR will have to maintain and update the panel of peers and in choosing the peers for assessment, due weight should be given to their research and development expertise so that the CSIR scientists who are working in applied and development tasks will be correctly appraised by the persons with similar background and experience. As is done in DRDO all promotions in the cadre of scientists may be effective in any calendar year on the same day irrespective of the actual date of assessment.

6.5 If CSIR has to emphasise technology and development then it has to plan in terms of multi-disciplinary teams which may be from within the same laboratory or from different laboratories within the CSIR. In large process or system development projects, planning, management, coordination and interfacing becomes very vital and as important as technology for the success. If the senior scientist leading the team is good in his subject as well as in management then it is indeed a fortunate situation. In cases where these are not found in the same person, preference will have to be for a scientist with better management skills to be the project or team leader. This has been practised with great success in the ISRO wherein relatively younger scientists with better management skills have been entrusted with the leadership of the projects while the team consisted of senior scientists as well as scientists with more indepth knowledge and specialisation than the leader. CSIR will thus have to evolve a personnel policy to recognise managerial talents among the scientists and have an award system by which their contribution is rewarded.

RECRUITMENT AND PROMOTION

6.6 While the basic emphasis in personnel policy is to reward group performance, individual excellence should also be recognised and retained. In order to bring in excellence in research and encourage those who are gifted and creative we suggest that in addition to the prevailing scientific stream recruited in accordance with the prevailing rules, pay-scales and perquisites, CSIR introduce, on an experimental basis, a parallel special stream on contract basis. This special stream would comprise those who have excelled in areas of interest to CSIR, appointed purely on non-renewable contract of six years, on a salary 50% higher than that for the normal scientist stream. The persons in the special stream would not be governed by prevailing rules relating to seniority and lien in the CSIR. The number of scientists in the special stream would not normally exceed 10% of the total sanctioned scientific staff strength. Some outstanding meritorious scientists from the normal stream could be considered for induction into the special stream, but once having opted for the special stream, they cannot automatically revert back to the normal stream. On expiry of the contract of a scientist in the special stream he could compete afresh and be considered for induction into the normal scientist stream.

6.7 We seek to combine the present 'merit promotion' and 'assessment promotion' schemes into a single composite one. We would recommend that an annual assessment of performance be carried out for each scientist by a committee comprising the Director and the concerned Project or Area Coordinator and the performance rated on a score/marking system. He would then be considered for promotion only on accumulating a minimum pre-defined total score, irrespective of the time taken to accumulate that minimum score. A suitable performance evaluation criteria for output, efficiency, quality of work would need to be devised on a scoring system. This should not be based only on individual performance but also on what the person contributes to 'group' or 'corporate' objectives. The promotion would then be decided by a peer review. All promotions would be effective on the first of January and June of a calander year nearest to the date of eligibility of the candidate for promotion.

6.8 It is important that young scientific talent be attracted to research as a career. For this purpose, we suggest that the promotional avenues in the CSIR be more liberal at early stages of a scientist's career than at later stages. We would also suggest that CSIR introduce campus recruitment of potential talent so as to motivate promising young persons to take up research as a career.

6.9 On reaching the age of 50 or on completion of 20 years of service in the CSIR a person's potential to contribute to future programmes and activities of CSIR needs to be assessed for his continuation. We feel that there are many scientists in the CSIR who have reached the end of their creative period but yet have the potential to make worthwhile contributions in other areas of endeavour. Such persons could be offered generous superannuation terms to motivate them to move out of CSIR system thus paving the way for young talent to be inducted into the system.

6.10 The key to the success of any laboratory is going to be the Director. There have been instances where moribund laboratories have been revitalised by gifted Directors. There have also been many cases where persons had held the Director's position for 15 to 20 years. In this process they had stifled the growth of both the scientists and of the laboratory. It is recommended that the Director be given non-renewable term of six years in a particular laboratory. The option to be absorbed at a similar level in another laboratory or at the Headquarters be left open. It is recommended that the Director designate be named at least three months prior to the completion of the term of the incumbent Director.

6.11 The Director should concentrate exclusively on providing scientific and technological leadership and not get involved in matters relating to administration and finance. For this he must be supported by a professional manager.

MOBILITY

6.12 Movement of CSIR personnel to outside organisations reflects not only on the professional worth of the individual but also in-

directly on the intrinsic value and quality of work pursued in CSIR. During the three years 1983-86, less than 3.5% of the scientists had worked professionally in an outside organisation for periods exceeding four weeks. Even movement of scientists within the CSIR was minimal. This insular approach is not conducive for an organisation whose business is creativity. Recently, a CSIR committee considered the issue of mobility and suggested incentives and administrative reforms to promote it.

6.13 We have given serious thought to improving mobility. We appreciate that in the Indian context there are over-riding personal, social, and economic factors which inhibit mobility. Thus although mobility cannot be forced or accomplished by fiat, we seek to place the onus for the outward movement of a scientist both at the individual and organisational levels. We suggest that a scientist's deputation to another organisation be accorded a high weightage in his performance ratings. At the organisational level we suggest that CSIR endeavour to ensure that at least 5% of its scientists are mobile every year. It should facilitate the placement of scientists through the Human Resources Development Group. No distinction should be made in placement with a Government organisation or a private sector unit. To motivate scientists to move under prevailing conditions we recommend the following facilities and incentives be accorded to them:

(i) the period of deputation be considered as on duty and the scientist be entitled to all benefits thereof, e.g., retention of residential quarters, counting of service, accrual of increments etc.;

(ii) honorarium at 20% of salary to be paid by CSIR in addition to the deputation salary drawn from the host organisation;

(iii) transfer TA/DA to be paid on actuals by CSIR; and

(iv) additional Earned Leave at one-sixth of the period spent on deputation subject to a ceiling of one month.

6.14 CSIR already has several good schemes for 'visiting scientists' to CSIR. The committee would like to make these more broad-based to include experts not only in science, technology but also engineering, economics, management etc. To make these schemes more attractive we suggest the following measures:

(i) CSIR provide the 'Visiting Expert' with suitable accommodation; and

(ii) CSIR pay the 'Visiting Expert':

(a) Actual pensionary/retirement liability in addition to his deputation salary.

(b) Transfer TA/DA on actuals.

(c) Travel Charges for one visit to hometown or Headquarters for the 'Expert' and his family every year.

6.15 In order to enrich CSIR's interaction with eminent persons from academia, research, engineering, management and industry, we make a special plea for instituting a scheme for 'Distinguished Fellows'. 'Distinguished Fellows' could be invited to work in CSIR laboratories for a period upto two years. To make this a prestigeous fellowship, we recommend that the fellowship amount be Rs.10,000 per month. The number of fellowships should not exceed ten.

TRAINING

6.16 We recognise that CSIR Headquarters is aware of the need to do forward planning and thinking on matters relating to research and development strategy. But where we find little urgency is in tackling the problem of an obsolescent human capital stock. More than 80% of CSIR personnel are those who received their basic training in the fifties and sixties. Worse still, during 1983-86, only about 10% of the scientific staff were imparted training in institutions outside the CSIR. While thrusts in terms of areas where

R&D activity should be concentrated are being identified by CSIR Headquarters, we believe that a more fundamental thrust area is that relating to cadre planning and management. Here CSIR Headquarters must play a direct and a larger role. The need for a focal point for training in the CSIR system is dictated by five factors. First, the system of recruitment being at the laboratory level, the individual scientist is plunged directly into the activities of the laboratory without having an appreciation of the entire CSIR system, its nature and programmes; thus the scientist does not perceive any organisational identity or link with the rest of the CSIR system. Second, in the absence of multi-laboratory projects, the individual scientist is not in a position to fully interact with his peers and colleagues elsewhere who would benefit him in his work. Third, the near absence of mobility has meant that scientists stay put and do not acquire first-hand knowledge and experience of operating environment. Fourth, the nature of tasks assigned in the laboratories to new scientists is not designed to provide an opportunity for them to be exposed to industry and its problems or to understanding the concerns of entrepreneurs. Fifth, the nature of scientific education and training is such that there is very little exposure to other important disciplines like economics, management, science and analysis that determine the success of scientific activities. As the CSIR system moves into multi-laboratory, multi-institutional, mission-oriented-programmes and technology development tasks, such a training is imperative.

6.17 It is thus recommended that the Human Resources Development Group be charged with systematic and planned career development of all S&T staff. A Central Training Institute be established and entrusted the responsibility of training, retraining and orientation needs of the entire CSIR fraternity. In our view the most suitable location for it could be near Bangalore, Hyderabad or Delhi. The Training Institute would thus be responsible for:

(i) common orientation training for entry level scientists;

(ii) refresher courses and training programmes for scientists in instrumentation, computers and other S&T areas;

(iii) management training for middle and senior level scientists;

(iv) refresher and skills upgradation programmes for technical staff; and

(v) training programmes on new management techniques for Administrative/Finance staff;

6.18 To promote scientific interaction especially at working levels, and to spot talent CSIR should organise three to five day specialist conferences, similar to the well-known Gordon Conferences. Young scientists from different laboratories together with some senior scientists in that specialisation should come together, present papers and proposals in an informal atmosphere. This will provide integration, opportunity for expression by younger scientists and creativity from unstructured collisions.

7 RESTRUCTURING OF LABORATORIES

7.1 The imperative for restructuring of CSIR laboratories at the present moment of time is dictated by many considerations. First, rightly or wrongly, Government has set up many scientific departments in areas of CSIR's activity. CSIR's structure should reflect these changes so that more appropriate system of accountability and responsibility are established. Second, the laboratory and its users have to be brought closer. Third, duplication in R&D work has to be avoided and disparate pockets of competence have to be welded to work on specific problems. Fourth, the capability to handle large projects, missions, and tasks has to be developed. Fifth, a sharper focus and greater clarity in a laboratory's activities is required so that each laboratory will have a dominant emphasis and not diffuse its energies in a number of directions.

Transfers

7.2 We are concerned with making the laboratories now under the CSIR umbrella more productive and effective. Some laboratories have a more effective place in other scientific organisations. Their natural destinies lie elsewhere. They should become part of the system which is more relevant to their growth discipline. Laboratories working in the areas specific to newly created scientific departments should be delinked from CSIR and placed with them. This would lead to the establishment of proper systems of accountability and responsibility. The resulting vertical integration would enable an optimum utilization of the investments and resources of the laboratory and of the Department. Such restructuring is not only necessary with respect to CSIR laboratories alone but also of activities of some of the laboratories of other Scientific Agencies and Departments as well. The British from whom we derived the inspiration for the CSIR model have themselves relocated the laboratories with those agencies with which they are closely aligned. We thus perceive the following factors which would suggest the transfer of a laboratory to a Scientific Department :

(i) CSIR laboratory having a charter of S&T activities of direct relevance to the Scientific Department;

(ii) Scientific Department with a focus and a culture that is scientific rather than departmental; and

(iii) Comparative merits of vertical integration with the Scientific Department vis-a-vis horizontal linkage with CSIR.

On this basis, we recommend the transfer of :

(i) The National Institute of Oceanography to the Department of Ocean Development;

(ii) The Institute of Microbial Technology and the Centre for Cellular and the Molecular Biology to Department of Biotechnology; and

(iii) The National Environmental Engineering Research Institute to the Department of Environment.

The autonomy and independence of the transferred laboratories must be preserved through an appropriate society-type structure like that of CSIR.

7.3 We would like to suggest an expanded role for the National Institute of Science, Technology and Development Studies (NISTADS). NISTADS has a key role to play in dealing with policy issues relating to research planning and technology development, not just for CSIR but indeed for the entire S&T sector. This role assumes even greater importance given the fragmentation of S&T planning and administration that has taken place in the Government. It would be worthwhile considering giving the Department of Science and Technology (DST) nodal responsibility for S&T planning cutting across all scientific agencies and departments so that a formal mechanism for developing an agenda for integrated approach to development is established. NISTADS could then be transferred to DST so that both can operate on a larger canvas and bring about a much needed sense of coherence and coordination to our entire S&T effort.

Closures

7.4 Over the years, CSIR has set up 100 field and extension centres spread all over the country with a wide range of functions, namely :

(i) to conduct trials under local-specific conditions;

(ii) to help exploit natural resources of the region;

(iii) to provide liaison with local users for extension of results of research; and

(iv) to provide maintenance and testing services.

7.5 These units have differed widely in terms of their size, organisation, nature of work and effectiveness of their performance. CSIR has recognised that these units have not adequately fulfilled the objectives for which they were established. In 1981 it set up a Committee to review the functioning of all the centres. This Committee had recommended that CSIR should not divert its attention and resources to operating these units. We are also of the view that CSIR divest itself of all of such centres by the end of the Seventh Plan. However, CSIR should make efforts with the concerned users such as Public Sector Enterprises, State Governments and Local Agencies to take them over; Central Government assistance could be provided for supporting them, if required. If no suitable taker is found, these units should be closed down with the staff being absorbed in the CSIR net-work.

Redesignation

7.6 Regional Research Laboratories (RRLs) have been established with the objective of providing S&T inputs to help exploit 'regional' resources. However, presently most of them are working on problems which transcend 'regional' needs and their clientele extends to the whole country. The 'regional' component of their name is therefore anomalous. We have already recommended that CSIR laboratories sharpen their focus on not more than three areas of excellence, to be chosen in accordance with their strength. It would then be more meaningful if these laboratories are renamed to reflect

the clear direction and orientation of their expertise and excellence. Thus :

(i) RRL, Bhubaneswar be renamed as "Central Minerals Processing Laboratory";

(ii) RRL, Hyderabad be renamed as "Central Institute of Chemical Technology";

(iii) RRL, Trivandrum be renamed as "Central Plantation Products Laboratory";

(iv) RRL, Jammu be renamed as "Central Laboratory for Natural Products"; and

(v) RRL, Jorhat be renamed as "Central Laboratory for Agri-products and Agri-chemicals".

The RRL, Bhopal has yet to evolve to a minimum threshold in terms of scientific manpower, infrastructure and, above all, direction or specialisation. The CSIR should explore the possibility of the State Government taking over this laboratory and running it as a laboratory for Forest and Mineral products. The staff would have the option of being absorbed by the State or returning to the CSIR network. If the State Government is unwilling to take it over, then it should be closed down.

Mergers

7.7 Publications and Information Directorate (PID) and Indian National Scientific Documentation Centre (INSDOC) jointly perform two important roles – publishing of primary periodicals, monographs, reference books and running of anticipatory information service. Presently most S&T Agencies and even inhouse R&D units have good S&T referral resources and the pressure on INSDOC/ PID to supply information and documentation of a routine nature has declined over the years.

7.8 The National Science Library has recently been established as a part of INSDOC, while the proposal to establish the National Science Press is yet to be implemented. CSIR has a proposal for the establishment of a Central Institute of Scientific Information and Publication by merging PID and INSDOC.

7.9 We subscribe to the view to merge PID and INSDOC. This would enable consolidation of information service around a strong National Science Library, a net-worked anticipatory information service and a translation service of foreign languages. Expertise in each of the areas is available in various degrees of excellence within the two institutes. These could become more effective and efficient through their merger.

Revitalising

7.10 We are concerned about the future activities of the Central Mechanical Engineering Research Institute (CMERI), the Central Electronics Engineering Research Institute (CEERI) and the Central Salt and Marine Chemicals Research Institute (CSMCRI). These laboratories have the potential to contribute significantly in the success of the programmes of some of the Societal and Technology Missions and in achieving productivity improvements in Industry. It is recommended that a group of experts be constituted to look into the ways and means to improve the performance of these laboratories and action be taken to put them on a stronger footing.

Research Programming

7.11 Planning and programming of R&D activity for the laboratories have to be done in an integrated manner so that the maximum synergy of talent and resources is obtained. In the organic chemical technology area, the National Chemical Laboratory (NCL), and the Regional Research Laboratory, Hyderabad (RRL, Hyderabad) have to work in close concert with each other. In the area of drug development, the Central Drug Research Institute (CDRI), NCL, and the RRL, Hyderabad would benefit from a coordinated approach to the planning of projects and programmes.

7.12 At present, plant tissue culture work is being done at the National Botanical Research Institute (NBRI), NCL, the Central Institute for Medicinal and Aromatic Plants (CIMAP), and to some extent, at the Central Food & Technological Research Institute in Mysore (CFTRI). It would be useful to concentrate tissue culture work on ornamental and essential oil-bearing plants at CIMAP, crop plants at NBRI and trees and plantation crops at NCL.

7.13 Similarly, there is a need to have an integrated information system and laboratory support dealing with all aspects of problems in toxicology. It is recommended that the Industrial Toxicological Research Centre (ITRC) concentrate on environmental and industrial toxicology, the CDRI on drugs, chemicals and ingestants toxicology, RRL, Hyderabad on pesticide toxicology, and the CFTRI on food toxicology. These Laboratories should be equipped with facilities required for doing toxicology work according to the WHO and FAO regulations and should provide testing facilities for not only Government organisations but also for the private sector for biological clearance purposes.

7.14 Fermentation technology work is being done in quite a few CSIR laboratories. Here again, it might be useful to concentrate and bring about coordination of work in three laboratories – RRL, Jammu, RRL, Jorhat, and CFTRI.

7.15 While we have recommended transfer of the CCMB and IMT to the Department of Biotechnology, there is need for a close coordination between the CSIR laboratories and these two Institutes to mount an integrated effort to combat major infectious diseases in the country like malaria, hepatitis, amoebiasis, and leishmaniasis. It is necessary to have central policy planning and to allocate resources accordingly. Within the CSIR system, the Indian Institute of Chemical Biology (IICB) should focus on parasitic diseases and the CDRI on anti-fertility work covering both chemical and immunological approaches.

7.16 There is considerable scope for pooling together the resources available in different CSIR laboratories in the area of micro-elec-

tronics, more specifically on manufacture of VLSI. For instance, the Central Electronics Engineering Research Institute (CEERI) could take up simulation of VLSI manufacturing process with a view to predict and control the circuit parameter variations. The National Physical Laboratory (NPL) can take up characterisation of physical phenomena which cause accelerated degradation of sub-micrometer circuits. The Central Scientific Instruments Organisation (CSIO) may be interested in the design of instrumentation for automation of the fabrication process.

7.17 CEERI, CSIO and the Central Glass and Ceramic Research Institute would have to mount common programmes to deal with electronic materials, miniaturisation of electronic components and development of instrumentation with processing and fabrication.

7.18 Linkages are not only to be established within the CSIR system but have to be fostered with other R&D-Agencies as well. For instance, the work of the Central Building Research Institute would benefit from a coordination with the activities of the National Buildings Organisation and the National Council for Cement and Building Materials. We feel that CSIR Headquarters must be alive to these possibilities and constantly be searching for ways and means for ensuring horizontal linkages between CSIR laboratories and laboratories outside the CSIR system.

Location

7.19 A few CSIR laboratories are situated in places not at all conducive to intense interaction with users or to attracting and retaining talent of the highest order. Research facilities need to be concentrated in areas that have a culture for research. Location of laboratories should be such that major research facilities such as sophisticated instruments, workshop, maintenance and many administrative and management functions can be shared. Simply put, research would benefit from agglomerative scale economies. If this means concentration of R&D facilities in a few locations, so be it. Location and continuation of an existing location should not involve pandering to regional sentiments. The possibility of shifting some labo-

ratories from relatively remote places for example the Central Electrochemical Research Institute, at Karaikudi to more appropriate locations be given serious consideration.

Size of Laboratories

7.20 It would be preferable to correlate the size of the laboratory to the needs of its legitimate functions rather than by filling it with research projects to keep the staff preoccupied. Many CSIR laboratories have been allowed to grow to such an extent that man management problems are biting into the time of laboratories and their Directors. The recently established institutions should have a total staff of around 350 with scientific staff strength of 125 to 150. The size of the larger institutions should be progressively reduced to a level of not more than 750 persons.

7.21 There is an urgent need to drastically curtail the non-S&T staff strength in the laboratories. The ratio of scientific to non-scientific staff in the CSIR system is 1:3. By contracting out non-scientific services and by adoption of modern office management practices, we feel that over the next three years the ratio of scientific to non-scientific personnel in CSIR can be brought to the level of 1:1.5.

8 GOVERNMENT POLICIES

THE PROBLEM AND THE SETTING

8.1 It is widely accepted that technology is central to the process of industrialisation and economic growth. But that is not all. The direction and pace of technological development influences not only the pace of industrial growth but also the nature of structural change in the industrial sector. There are a number of sectors in India where the level of technological development is not adequate and, hence, not commensurate with the needs of the economy. It is possible to cite many examples of situations where technologies were imported for particular sectors at a point of time, and the absorption of such technologies has been followed by stagnation rather than adaptation, diffusion, and innovation. At the same time, indigenous technological development, whether in the corporate sector or in the CSIR system, has not led to continuous technological upgradation. The underlying reasons are manifold and complex any discussion of which would mean a considerable explication. Suffice it to say that the reasons cannot be located in the failure of the CSIR alone. It is as much a failure of the corporate sector, whether public or private, on the one hand, and the errors of policy whether of omission or commission, on the other.

8.2 In this Report, we have suggested a number of mechanisms whereby the CSIR system would interact with industrial sector in particular, and its potential users in general, to foster indigenous technological development. This objective would forever remain a mirage, unless we can create a framework of policies which would enable the economy to move from importation to absorption, adaptation and diffusion of technology through to the stage of innovation, at least in some sectors, on the path to sustain industrialisation. For this purpose, it is important to recognise that there is a clear nexus between fiscal policies, industrial policies and trade policies which can have a profound impact on the nature, the pace and the depth of technological development. It is our considered view that an integrated set of economic policies should provide a

judicious blend of carrot and stick which would accelerate the absorption of imported technology, foster the development of indigenous technology and create an environment which would be conducive to innovation.

8.3 The policy framework should, therefore, have two specific objectives. For one thing, it should seek to stimulate the supply of, and generate a demand for, indigenous technology. For another, it should endeavour to create an environment in which there is a pressure on, and an incentive for, domestic firms to absorb and adapt imported technology. In the pursuit of these objectives, the guidance, the support and the commitment of the Government, which goes beyond the creation of a framework of policies, is imperative. State intervention at the macro level would increase the impact of economic policies at the micro level. On the part of the Government, there must always be a clear perception of the distinction between short-run aims and long-run objectives. This is particularly, important in the realm of technology, where the need for planning at the macro level is paramount. Just as investment planning is about much more than the allocation of resources, technology planning is about much more than the absorption of imported technology and the development of indigenous technology.

DEVELOPMENT OF INDIGENOUS TECHNOLOGY

8.4 Consider first, the issue of indigenous technological development. Our past experience suggests that, more often than not, we have failed to stimulate the supply of such technology and to create the demand for such technology. The policy mix must be addressed to both sides of this coin.

8.5 Elsewhere in the report, we have suggested that, by the end of the Seventh Plan, the CSIR must finance at least one-third of its expenditure through sponsored research. This would obviously put pressure on the CSIR system to earn its keep. At present, however, there is no pressure on, or incentive for, the corporate sector to sponsor research in the CSIR system or, indeed, to further

the cause of in-house R&D within firms. To resolve this problem, we would suggest the following change in the regime of fiscal policies. The Government should impose a cess of 0.75 per cent on the ex-factory value of output, which constitutes a minimum level of R&D expenditure. For every firm, the following sums would be deductible from the cess payable: (i) the actual R&D expenditure within the firm; and (ii) 133 1/3 per cent of the amount provided to sponsor any research in the CSIR and the Universities. To the extent that it does not, the cess payable would provide the government with the resources to further the same objective. It must be clarified that the objective of the cess is not to raise revenue; indeed, in the ultimate analysis, the measure would have succeeded when it yields no revenue.

8.6 Insofar as the corporate sector provides resources for R&D, whether in-house, or at the CSIR, or in the universities, it would obviously be interested in the commercialisation of technologies that emerge from this effort. But that cannot suffice. The policy framework should also attempt to strengthen the demand for such technologies. An important step in this direction would be to reward the use of indigenous technology through the provision of appropriate incentives and facilities. We would recommend the following set of measures. First, any firm which uses indigenous technology should be entitled to the benefit of accelerated or, if possible, free depreciation on the investment made. Second, to facilitate investment in production processes based on indigenous technology, soft loans should be made available by the public financial institutions on the same terms as soft loans for modernisation. Third, the regime of industrial policies should relax the restrictions on capacity creation and capacity expansion on the part of any firm that seeks to establish production capacity using a technology developed within India. We understand that this concession is available to non-MRTP and non-FERA companies for quite some time but without discernible impact so far. It would be advisable to extend the relaxation to MRTP companies, who have the resources to develop technologies and the capacity to take risks, but it would need to be ensured that this concession is provided for genuine and new indigenous technology.

8.7 The development and use of indigenous technology is often constrained by the problems associated with the transition from scientific results in the laboratory to a reliable and complete technology for manufacture. The internationally accepted average ratio for expenditurc relating to laboratory-scale research, pilot-plant development and commercial-scale activity is 1:3:10. On the basis of this norm, the successful laboratory research in the CSIR system, at present, would need a post-laboratory-scale development expenditure of approximately Rs. 100 crores, if the scientific results are to be transformed into commercially viable technologies. In fact, the present level of development expenditure on post-laboratory-scale activities is a mere Rs. 1 crore. For know-how developed in the CSIR system, it is essential that we provide venture capital for pilot plants and demonstration plants, which can easily be financed from the cess proposed by us. It is worth stressing, however, that the pilot plants must be located at the place of ultimate use and not in the CSIR laboratories. At the same time, to facilitate the aforesaid transition, it is necessary to provide both resources and support to domestic design engineering firms, which have so far played second fiddle, if that, given the increasing incidence of technology transfer through turn-key plants.

8.8 The incentives and facilities for the development and the use of indigenous technology are, of course, a part of a much wider canvas. In the ultimate analysis, firms would be pushed in this direction if and only if they are induced by an expectation of higher profits, a fear of competition or a threat to survival in the market. For this purpose, the regime of industrial policies must ensure that: (a) scales of production are not sub-optimal, (b) growth in the size of the firm is not limited, and (c) barriers to entry by new firms and expansion by existing firms, do not limit competition, which is a necessary condition for technological development. The objective of increasing the degree of competition among firms should not obviously be pursued in a simplistic manner by enlarging the number of firms or fragmenting capacities. It should be recognised that where oligopolistic market structures are inevitable, given the minimum viable scale and the size of the market, competition can and must be calibrated in a different manner.

8.9 The present import policy regime does provide the necessary access and facilities to support R&D for indigenous technological development insofar as most equipment for R&D is importable on OGL. As a specific measure, we would further suggest that the customs duty on imports of equipment for R&D in the industrial sector should be at the same level as the customs duty on project imports.

8.10 The regime of trade policies, however, has a wider and more fundamental role. We may stimulate the supply of indigenous technology, as also create a demand for it, through a mix of fiscal and industrial policies. But this effort would come to naught if the competing firms are provided with liberal access to imports of technology in the very same sectors. Therefore, imports of technology embodied in capital goods and imports of disembodied technology in the form of know-how would need to be coordinated with the regime of fiscal and industrial policies in particular, and with technology policy in general.

ABSORPTION OF IMPORTED TECHNOLOGY

8.11 Consider now, the framework of policies apropos the import of technology. In this Report, we are not directly concerned with the parameters of the import decision which is a complex and important issue in itself. We are concerned more with what happens afterwards. Imports of technology are, more often than not, followed by stagnation simply because the firms which import technology are primarily interested in the stream of output and the immediate profits that emerge from the use of such technology. In general, therefore importing firms are not interested in developing their technological capacities beyond the level necessary to realise their basic aim in terms of production. The objective of absorption is secondary. The objective of learning-by-using or learning-by-doing is tertiary, if that. After all, the soft option of importing the new vintage of technology, when tomorrow comes and there is need for upgradation, always remains. In such a context, it is not surprising that importation is not always followed by absorption, let alone adaptation or diffusion, and seldom leads into innovation. We

believe that the framework of policies must play an important role as a corrective. It is necessary here to make a distinction between the private sector on the one hand and the public sector on the other, as the role and the importance of the CSIR cannot be the same with respect to both.

8.12 In the private sector, where royalties, technical fees and lumpsum payments for the import of technology exceed Rs. 2 crore over the period of collaboration, it is essential to create a mechanism which would ensure absorption of the imported technology within the firm and subsequently, facilitate its further development and horizontal diffusion outside the firm. For this purpose, it is recommended that an eminent technologist should be appointed on the Board of Directors for every such firm that imports technology, in much the same way as public financial institutions appoint their nominees on the Board of Directors. This would provide an important complement to the set of measures recently announced by the Government including the submission of a detailed technology absorption plan.

8.13 In the ultimate analysis, however, we believe that the transition through absorption to innovation has to be facilitated within the enterprises in the private sector. For this purpose, we would suggest that every firm which imports technology must be bound to undertake minimum level of R&D expenditure. While it is difficult to indicate a precise figure, we would suggest that for every rupee paid as royalties, technical fees and lumpsum payments per annum for the import of technology, the firm must spend at least one rupee per annum on in-house R&D to be directed towards the absorption of the technology. To the extent its actual R&D expenditure falls short of this minimum commitment, the firm would have to pay the difference as a fiscal levy to the Government.

8.14 In the public sector, the role of the CSIR in technology absorption and development can and should be much more active. We believe that CSIR personnel from the appropriate laboratories should be associated with the acquisition of imported technology by public sector undertakings right from the beginning, that is, the

stage of negotiations and the choice among alternative sources. The package of know-how and know-why so imported by the public sector undertaking should be commercialised for production with the active association of the same CSIR scientists and engineers, who would thus have a participative and interactive role in the early stages of absorption, whether through learning-by-using or through learning-by-doing.

Thereafter, the public sector undertaking, in collaboration with the CSIR team, should prepare a concrete action plan for the absorption, upgradation and ultimate development of technology in that sector. Where this task cannot be performed in manufacturing enterprise, the team from the CSIR should return to its laboratory with a commitment to upgrade and develop the imported technology within a finite period of time agreed in consultation with the public sector undertaking. For this period, both the public sector undertaking and the Government must abide by their commitment to the CSIR and afford it the opportunity of technological upgradation and innovation.

BEYOND THE POLICY FRAMEWORK

8.15 It needs to be recognised that a framework of policies can only create an environment that is conducive to the absorption and the development of technology. The package of policies suggested by us is necessary but not sufficient. For, we can only open a door, we cannot compel entry. After all, it is widely accepted that a firm's technological resources and expertise are as important as its financial strength, but it is an unfortunate fact of corporate practice in India that the former does not receive the attention it deserves. More often than not, firms are content to be users of technology. This culture stems, *inter alia*, from the nature of organisation in production and the degree of competition in the market. The realisation of the objective we have in mind would be possible when the corporate sector recognises that technology gives it a competitive edge. This recognition can only derive from the compulsions of competition before it is followed by the necessary emphasis on R&D. It is clear that a firm can absorb technology if

it has developed adequate R&D ability, and the essential receptivity, which must be part of a longer term corporate plan.

8.16 In conclusion, we would like to stress the strategic role of the Government, at a macro level, in planning for technological development and structural change in the economy. There must be a vision, if not a grand design, which would chart the sectoral-mix and the temporal-sequence of technological development. This means planning for the acquisition of technology where it is to be imported, setting aside resources for the development of technology where it is to be produced at home, or even deciding to opt out of a technology where it is not needed. These perceptions and judgements can be derived only from a continuous interaction between the Government, the industry and the community of scientists-engineers-technologists. In such a context, the CSIR system would be a part of a much larger whole. It would provide an interactive input to a think-tank for technology policy which could perhaps be based in the Planning Commission. It is imperative, however, that such a group, which is made responsible for the planning and development of technology in India, must have the authority to implement its decisions that would be in the nature of strategic guidelines and binding parameters. The guiding and supportive role of the Government has indeed been at the foundations of technological development among the late industrialisers. Such an approach, it need hardly be stressed, calls for more, not less, State intervention, but the nature and the quality of this intervention has to change.

9 RECOMMENDATIONS

Charter of CSIR

9.1 The Charter of CSIR and the associated laboratories should reflect the changes suggested in this report.

R & D Areas

9.2 The CSIR should concentrate its resources and direct its research programmes for:

(i)) Technology Missions and Generic Technology Programmes;

(ii) Societal Missions;

(iii) Sponsored Research; and

(iv) Basic Research

9.3 The CSIR should identify specific corporate opportunity/ thrust areas in S&T which are sufficiently challenging and commensurate with the overall capabilities. The CSIR should commission Technology Forecasting exercises in selected sectors to derive therefrom the corporate thrust areas. A group of experts could then convert a thrust area into its components and laboratories assigned specific responsibilities. Each laboratory should not have more than three areas of specialisation. The laboratories would then ensure that at least 50% of their resources, both manpower and financial, are devoted in the chosen areas of specialisation.

Technology Missions

9.4 CSIR Headquarters should take the lead and prepare detailed project reports on a set of technology development and technology application missions by April 1987. These reports would then be

finalised by the Planning Commission. In order to establish credibility, CSIR should isolate three missions from this set which it would be able to complete in a period of five years. All necessary support for successful completion should be provided.

Earnings

9.5 The CSIR should be required to obtain at least one-third of its total annual expenditure from outside the Central Government Core Grant by the end of the Seventh Plan. This would include sponsored research from Government Agencies as well as from industry. The CSIR should internally decide on the level and programme of external funding to be earned by each laboratory. CSIR should be permitted to retain and utilise its earnings instead of surrendering these to the Consolidated Fund of India.

Project Budgeting

9.6 Zero-based budgeting be uniformaly adopted by all laboratories by the end of the Seventh Plan. Funding must be on a multi-year and assured basis; for missions it could be for the span of the mission and for basic research initially over a two year period. Resource allocation on project basis and project budgeting, accounting, and costing be adopted by CSIR and the laboratories.

CSIR Society

9.7 CSIR should take advantage of the benefits that its society-type structure offers. It should make all efforts to convert itself into the truly autonomous society which was the original intention. Necessary changes in the bye-laws should be effected to make this possible.

Governing Body (GB)

9.8 The composition of the Governing Body should be the following:

(i)	Eminent Professional	Chairman
(ii)	Director-General	Member
(iii)	Member Finance	Member
(iv)	Two Directors of CSIR Laboratories	Members
(v)	Two eminent Industrialists/ Technologists	Members
(vi)	Two eminent Scientists at least one of whom is from a University	Members
(vii)	Executive of a Public Sector Enterprise	Member
(viii)	Eminent Industrial Economist	Member
(ix)	Eminent Consulting Engineer	Member

Secretary of the GB to be nominated by DG CSIR.

9.9 The term of the GB shall be for a period of three years. The GB should concern itself with laying down policy guidelines for the functioning of the CSIR laboratories, appointing Chairmen of Research Councils of laboratories, identifying new opportunity areas and policy measures for improving the climate for generation and utilisation of indigenous technology and review the performance of laboratories every two years. The other functions and powers of the present GB concerning routine administration and finance should be delegated to the Director-General and the Technical Secretariat.

Coordination Council (CC)

9.10 The Coordination Councils be disbanded as they have not fulfilled their objectives over a long period of time.

Headquarters - Laboratory Relationship

9.11 Laboratories should be further delinked from routine administrative and financial control of the Headquarters. The laboratories will be linked to the Headquarters only for:

(i) receipt and disbursement of the funds from the Government;

(ii) appointment of the Director and Research Council Members;

(iii) Technology and Societal Missions;

(iv) International and Interagency Scientific Collaboration;

(v) Research Fellowships and Training;

(vi) liaison and interaction with major users and Government Departments;

(vii) Data Bank of total CSIR R&D activities; and

(viii) Construction activity.

Research Council (RC)

9.12 For each laboratory the present Research Advisory Council be replaced by the RC which would consist of:

(i) Five outside experts including the Chairman;

(ii) Director of the laboratory; and

(iii) a senior scientist from another laboratory to be nominated by the DG CSIR.

9.13 The term of the RC would be for three years and it would meet at least twice a year. The external expert members would be simultaneously appointed as Consultants to facilitate their interactive role; they would be paid an honorarium of Rs.10,000 per year. The experts would be Consultants to the laboratory on a few projects in their area of expertise. They would need to meet every three months or so and put in a total of 8 days in a year at the laboratory for their assignment. The DG CSIR should annually review the performance of the laboratory in consultation with the Chairman of the RC and the Director. In the case of basic research programmes a peer review should be held every two years by persons nominated by the DG and their report submitted to him; the DG in consultation with the Director will then decide the future course of action.

Management Council (MC)

9.14 The present Executive Committee be replaced by a Management Council. It would consist of:

(i)	Director	Chairman
(ii)	A scientist representing each of the four scientific levels - B,C,E and F&G	Members
(iii)	Director or a senior scientist of another laboratory nominated by the DG CSIR	Member
(iv)	Director's level scientist from the laboratory, if in position, to be nominated by DG CSIR	Member
(v)	Administrative Officer and Finance and Accounts Officer	Members

Secretary to be nominated by the Director from amongst the members.

9.15 The term of the Management Council would be for three years coincident with the term of the RC. Its functions would be limited to administration and management of the laboratory so as to support the R&D plan approved by the Research Council. The Management Council would function as per the guidelines laid down by CSIR, its decisions and proceedings shall not need the approval of CSIR except where these depart from the prescribed guidelines.

The Director

9.16 The Director of a laboratory should concentrate on providing scientific leadership. To enable this, he must be supported by a professional manager who would take on the responsibility of administration, finance and the management of the laboratory system.

Technical Secretariat at Headquarters

9.17 Headquarters will mainly function as a technical secretariat and there would be three technical groups to assist the DG, viz.: Research and Planning Group, Technology Development Group and Human Resources Development Group. Each group shall be headed by a Chairman who shall have a status at par with that of a Director of a laboratory and a tenure of three years.

Research and Planning Group

9.18 This Group shall have the following functions:

(i) interact with Planning Commission, other agencies/ departments to catalyze the development/economic plans to S&T plans;

(ii) evolve a strategy for resolving these plans as Mission Projects and prepare/commission detailed project reports on some of the more critical missions;

(iii) identify networking of laboratories and institutions and assign tasks;

(iv) commission technology forecasting exercises to identify new opportunity areas of CSIR;

(v) provide secretariat for monitoring national/mission projects; and

(vi) International Scientific Collaboration and Research Schemes.

Depending upon the requirements, the Chairman could invite concerned experts from within the CSIR system to evolve/handle a specific task. These experts would not be linked or associated with the laboratories for any administrative purpose. The number of expert members of this group shall not exceed five and their tenure not more than three years.

Technology Development Group

9.19 The Group shall have the following functions;

(i) interface with CSIR's customers;

(ii) arrange for technology evaluation, upscaling and proving;

(iii) secure legal protection for and assist in contracting of CSIR know-how;

(iv) market CSIR technology and expertise and secure business;

(v) interact with Industry Associations, Public Sector Enterprises, Consulting Engineering Design Organisations; and

(vi) maintain the Central Information System for CSIR.

The number of expert members of this group shall not exceed five and their tenure not more than three years.

Human Resources Development Group

9.20 This Group shall have the following functions:

(i) career development of staff including training, deputation of scientists in India and abroad;

(ii) external manpower development through Pool Placement, Research Fellowships and Associateships;

(iii) science promotion;

(iv) administration and finance. Codification of administrative and financial rules, instructions and procedures to be followed by the MCs of the laboratories; and

(v) interact with Government Departments on matters of Finance and Administration.

Recruitment And Promotions

9.21 In order to bring in excellence in research and encourage those who are gifted and creative it is recommended that there be two streams of scientific personnel:

(i) the normal stream recruited in accordance with the prevailing rules, pay scales and perquisites; and

(ii) a special stream of contract appointments.

9.22 This special stream would comprise persons who have excelled in areas of interest to CSIR, appointed on a contract basis for a period of six years, at a salary 50% more than that for the normal stream. The number of scientists in this stream would not normally exceed 10% of the total sanctioned scientific staff strength. On expiry of their contract they could compete and be considered for induction into the normal scientists stream.

9.23 The existing 'merit promotion' and 'assessment promotion schemes' be combined into a single scheme. An annual assessment of performance should be carried out for all scientific staff and their performance rated on a score basis. They would be eligible for promotion only when they accumulate a minimum total score, irrespective of the time taken to accumulate it. Their promotion would then be decided by a peer review.

9.24 At the age of 50 or on completion of 20 years of service in CSIR, a person's potential to contribute to future programmes and activities of CSIR needs to be assessed for his further continuation. A scheme of voluntary retirement should be evolved with generous terms for superannuation.

9.25 The appointment of a Director in any laboratory should be for one non-renewable term of six years. On expiry of the contract, he could be considered for appointment as Director or as a Director level scientist in another laboratory or at Headquarters.

9.26 The CSIR should introduce campus recruitment of potential talent so as to motivate young promising talent to take up research as a career.

Training

9.27 The Human Resources Development Group should be charged with systematic and planned career development of all S&T staff. A Central Training Institute be established and entrusted with the responsibility of training, retraining and orientation needs of the

entire CSIR fraternity. The most suitable location for this Institute could be near Bangalore, Hyderabad or Delhi.

9.28 Scientists in CSIR need to be exposed to the R&D ethos and developments in other countries. Besides, bilateral exchange programmes, the CSIR should encourage and arrange for training of scientists overseas on specific programmes for periods not exceeding ten weeks at a time.

Mobility

9.29 A scientist's deputation to another organisation should be given a significant weightage in his performance ratings. The CSIR should endeavour that at least 5% of its scientists are mobile every year. It should facilitate the placement of scientists through its Human Resources Development Group. To motivate scientists to move, the following facilities and incentives be accorded:

(i) the period of deputation be considered as on duty and the scientist be entitled to all benefits thereof e.g., retention of residential quarters, counting of service, accrual of increments, etc;

(ii) honorarium at 20% of salary to be paid by CSIR in addition to the deputation salary drawn from the host organisation;

(iii) transfer TA/DA to be paid on actuals by CSIR; and

(iv) additional Earned Leave at one-sixth of the period spent on deputation subject to a ceiling of one month.

9.30 The scheme of 'visiting scientists' should encompass experts in science, technology, engineering, economics, management, etc. and be made more attractive through the following measures:

(i) CSIR provide suitable accomodation to them;

(ii) CSIR pay the visiting expert:

(a) actual pensionary/retirement liability, in addition to his deputation salary;

(b) transfer TA/DA on actuals; and

(c) actual travel charges for one visit per year to hometown for the expert and his family.

9.31 The CSIR should also endeavour to attract some personnel from Government Organisations like DGTD, Economic Ministries and Consultancy Units.

9.32 CSIR should institute a scheme of 'Distinguished Fellows' whereby, eminent persons from academia, research, engineering, management and industry be invited to work in CSIR laboratories upto a period of two years. A fellowship of Rs.10,000 per month be given to a 'Distinguished Fellow'.

Scientific Advisory Committees

9.33 All economic Ministries need to have Scientific Advisory Committees. These Committees should, have outstanding professionals drawn from various fields, meet regularly and receive sustained support from the bureaucracy.

DGTD

9.34 The role of the Directorate General of Technical Development (DGTD) should be reviewed so as to make it truly development oriented. DGTD should closely interact with CSIR to identify technological gaps in important industries and in working out programmes to overcome these.

Research in Universities

9.35 The CSIR has provided yeoman services in supporting research in Universities. This activity needs to be supported and strengthened. The Directors of the laboratories should also be given the authority to contract research to Universities in areas of interest to the laboratory, upto 3% of the total budgeted expenditure.

Technology Development and Transfer

9.36 The CSIR should involve competent Consulting Engineering Design Organisations for evaluation, assessment and marketing of CSIR know-how.

9.37 The sponsors of research projects should be given a 5 to 7 years exclusive period, from the date of completion of the project, to commercialise the know-how provided the sponsor takes concrete steps to implement the project. A limited exclusivity of 3 years could be considered for a pioneering unit availing of unencumbered know-how. CSIR should also ensure that:

(i) any unencumbered know-how developed be independently evaluated; and

(ii) wherever possible, the development team be encouraged to move to industry to assist in productionisation of the know-how.

9.38 The CSIR scientists should be encouraged to take up consultancy work to a greater extent, as this would sharpen their technological calibre. As a measure to achieve this, the present ceiling on honorarium receivable per annum be raised from Rs.15,000 to Rs.30,000.

National Research Development Corporation

9.39 The CSIR should be free to license and commercialise all its technologies and not be forced to assign the exclusive rights to the NRDC which hitherto had acquired monopolistic rights. The NRDC should compete on equal footing with others to bid for commercialising CSIR's technology.

RESTRUCTURING OF LABORATORIES

Size of Laboratories

9.40 Most laboratories have crossed their optimal size in terms of number of staff. Their staff strength should not be allowed to

expand further. The strength of the new laboratories should not be allowed to go beyond 350 persons and that of the older laboratories be constrained to 750 persons at the most.

9.41 There is an urgent need to drastically curtail the non-S&T staff strength in the laboratories, which has proliferated in the past. This can be achieved by modern office management practices and contracting out non-essential S&T activities. In the foreseeable future the ratio of scientific to non scientific personnel be changed from the present 1:3 to 1:1.5.

Modernisation

9.42 The CSIR should modernise its research equipment to meet the new challenges with confidence. An immediate grant of Rs.100 crore for this purpose should be made available in the remaining period of the Seventh Plan. Thereafter, the CSIR will keep abreast by modernising through its annual budget.

9.43 CEERI, CMERI and CSMCRI have the potential to contribute to the economy; a group of experts be constituted to look into ways and means to improve the performance of these laboratories and suggest action to put them on a proper footing.

Redesignation of Regional Research Laboratories (RRLs)

9.44 It would be more meaningful if the RRLs are reorganised to reflect the direction and orientation of the expertise and excellence developed by them. Thus:

(i) RRL, Bhubaneswar be renamed as "Central Minerals Processing Laboratory";

(ii) RRL, Hyderabad be renamed as "Central Institute of Chemical Technology";

(iii) RRL, Trivandrum be renamed as "Central Plantation Products Laboratory";

(iv) RRL, Jammu be renamed as "Central Laboratory for Natural Products"; and

(v) RRL, Jorhat be renamed as "Central Laboratory of Agri-Products and Agri-Chemicals".

Closure

9.45 RRL, Bhopal has yet to evolve at an adequate level. The CSIR should explore the possibility of the State Government taking it over and running it as a State Laboratory. Central Government assistance could be considered for its take-over and operation for a limited period. If this is not possible, then it should be closed down.

Mergers

9.46 PID and INSDOC should be merged as this would consolidate information service around a strong National Science Library, a networked anticipatory information service and a translation service.

Transfer of Laboratories

9.47 The following establishments of the CSIR should be transferred in view of the creation of new Scientific Departments of Government of India and their potential to contribute more effectively under the new arrangement:

(i) NIO to Department of Ocean Development;

(ii) IMT & CCMB to Department of Biotechnology;

(iii) NISTADS to Department of Science & Technology; and

(iv) NEERI to Department of Environment.

9.48 The autonomy and independence of the transferred laboratories must be preserved as is the case in the present setup with the CSIR, through appropriate independent Society structure.

Field, Extension, Regional Centres

9.49 The CSIR should divest itself of all of such centres by the end of the Seventh Plan. However, CSIR should make efforts with PSEs, State Governments and Local Agencies to take over the centres. Central Government assistance could be provided for supporting them, if required, for a limited period. Centres which cannot be accommodated as above should be closed down and the surplus staff could be absorbed in the CSIR system.

9.50 Research Programme Planning

Planning and programming for research activity should be done across laboratories. Considerable scope exists for integrating the skills and talents available in different laboratories in areas of organic chemicals, tissue culture, toxicology, fermentation technology, electronic materials, and instrumentation. They should also cover linkages with other scientific agencies and institutions which are working closely in allied fields, as for example, in the area of building materials, genetic engineering, and material sciences. In areas like metallurgy, petrochemicals and coal technology, there should be close coordination between R&D activities of CSIR laboratories and the in-house R&D units of the public sector enterprises concerned.

GOVERNMENT POLICIES

R&D Cess

9.51 In order to encourage R&D expenditure by industry and sponsorship of research at the CSIR, the Government should impose a cess of 0.75% of the ex-factory value of output. For every firm, the following sums would be deductible from the cess payable:

(i) the R&D expenditure incurred by the firm; and

(ii) 133.33% of the amount provided to sponsor any research in the CSIR system or in Universities.

Indigenous Technology

9.52 In order to encourage the use and commercialisation of indigenous technology:

(i) any firm which uses indigenous technology should be entitled to the benefit of accelerated, or, if possible, free depreciation for investment arising out of such technology;

(ii) the present restrictions on capacity creation or capacity expansion by MRTP firms should be relaxed for any production capacity based on new indigenous technology;

(iii) for users of indigenous technology, it is recommended that the Government provide venture capital for pilot plants and resources for design engineering, both of which can be financed from the proposed cess; and

(iv) to facilitate investment in production processes based on indigenous technology, soft loans should be made available by the public financial institutions on the same terms as soft loans for modernisation.

Imported Technology

9.53 To facilitate the absorption of imported technologies, that for every rupee paid as royalties, technical fees, and lumpsum payments, per annum for the import of technology, the firm must spend at least one rupee on in-house R&D to be directed towards absorption of that technology. If the actual R&D expenditure falls short of this minimum, the firm would have to pay the difference as a fiscal levy to the Government.

9.54 The CSIR should be associated with the acquisition of imported technology by public sector undertakings right from the beginning, that is, the stage of negotiations and the choice among the alternative sources. The CSIR scientists and engineers should form a

part of the team that commercialises the imported technologies in the form of production in the public sector undertakings. Thereafter, the public sector undertakings, in active association with the CSIR, should prepare a concrete action plan for the absorption, upgradation and the ultimate development of technology in that sector. The Government should nominate a CSIR scientist on the Board of Directors of public sector undertakings.

9.55 In the private sector, or the joint sector, where royalties, technical fees and lumpsum payments, for the import of technology exceed Rs. 2 crore over the period of collaboration, it is essential to create a mechanism which would ensure absorption of the imported technology within the firm and, subsequently, facilitate its further development and horizontal diffusion outside the firm. For this purpose, an eminent technologist should be appointed on the Board of Directors for every such firm that imports technology, in much the same way as public financial institutions appoint their nominees on the Board of Directors.

9.56 The customs duty on imports of equipment for R&D purposes by in-house R&D units in industry be at the same level as customs duty on project imports.

Policy Coordination

9.57 The regime of fiscal policies, industrial policies and trade policies should be coordinated to facilitate the objectives of absorption of imported technology and the development of indigenous technology.

High Level Co-ordinating Body

9.58 There should be a high-level think-tank constituted under the aegis of the Planning Commission to provide a forum for effecting coordination among various scientific and technological systems in the country.

Annexure - 1

CONSTITUTION OF THE COMMITTEE

The Prime Minister in his capacity as the President of the Society of Council of Scientific & Industrial Research appointed, in April 1986, a Committee to review the functions and structure of CSIR. The terms of reference assigned to the Review Committee were as follows:

(i) To identify the broad thrust of activities of CSIR laboratories so as to optimally utilise their capabilities.

(ii) To suggest how capabilities in different laboratories can be brought together by appropriate networking to meet identified objectives and specific missions.

(iii) What should be the system for an organic institutional link between CSIR and its prospective users, particularly major Government departments/public sector undertakings so that research is oriented towards the needs of users.

(iv) The role and corresponding structure of the CSIR Hqrs. in coordinating work between different laboratories, linkages with users, and to ensure that the whole system works towards the identified objectives.

(v) A broad review of personnel policies to ensure optimum development of the human resources in CSIR, which could include arrangements for mobility of scientists, their training etc.

(vi) How to build in a principle of accountability in CSIR where scientific work is judged by peer group appraisal and technological work by ability to meet needs of users.

(vii) Review the existing arrangements for transfer of technology and suggest how they can be strengthened, including a review of the NRDC mechanism.

(viii) Suggest incentives for work to be done by different laboratories which could include retention of contract earnings.

The following were nominated to the Committee :

1. Shri Abid Hussain, *Chairman*
   Member, Planning Commission,
   New Delhi

2. Dr. K.K.G. Menon, *Member*
   Vice President & Research Director,
   Hindustan Lever Ltd.,
   Bombay

3. Dr. T.K. Roy, *Member*
   Managing Director,
   Chemical & Metallurgical Design Co. Ltd.,
   New Delhi

4. Dr. R.P. Shenoy, *Member*
   Director,
   Electronics Research & Development
   Establishment,
   Bangalore

5. Prof. M.M. Sharma, *Member*
   University Department of Chemical Technology,
   Bombay

Subsequently

6. Shri T.V. Mansukhani, *Member*
   (The then) Chairman & Managing Director,
   Hindustan Machine Tools Ltd.,
   Bangalore

and

7. Prof. Deepak Nayyar, *Member*
   Centre for Economic Studies and Planning,
   School of Social Sciences,
   Jawaharlal Nehru University,
   New Delhi

were inducted as members.

Annexure - 2

VISITS AND CONSULTATIONS

RESEARCH/ACADEMIC INSTITUTIONS VISITED

A CSIR laboratories

(i) Centre for Cellular & Molecular Biology, Hyderabad

(ii) Central Drug Research Institute, Lucknow.

(iii) Central Glass and Ceramic Research Institute, Calcutta.

(iv) Central Institute of Medicinal and Aromatic Plants, Lucknow

(v) Central Leather Research Institute, Madras

(vi) Central Scientific Instruments Organisation, Chandigarh.

(vii) Indian Institute of Chemical Biology, Calcutta

(viii) Institute of Microbial Technology, Chandigarh

(ix) Industrial Toxicological Research Centre, Lucknow

(x) National Aeronautical Laboratory, Bangalore

(xi) National Botanical Research Institute, Lucknow

(xii) National Chemical Laboratory, Pune

(xiii) National Geophysical Research Institute, Hyderabad

(xiv) National Physical Laboratory, New Delhi

(xv) Regional Research Laboratory, Bhopal

(xvi) Regional Research Laboratory, Bhubaneswar

(xvii) Regional Research Laboratory, Hyderabad

(xviii) Structural Engineering Research Centre, Madras

Discussions were held with the Directors and the scientists (including young scientists) at the laboratories.

B. Research establishments of other Government Scientific Agencies

(i) Bhabha Atomic Research Centre, Bombay, of the Department of Atomic Energy.

(ii) Electronics Research and Development Establishment, Bangalore of the Defence Research and Development Organisation.

(iii) Space Application Centre, Bangalore, of the Indian Space Research Organisation.

C. In-house R & D Units

(i) Hindustan Lever Ltd., Bombay

(ii) Larsen & Toubro Ltd., Bombay

(iii) Bengal Immunity Ltd., Calcutta

(iv) Hindustan Brown Boveri Ltd., Baroda.

D. Academic Institutions

(i) Indian Institute of Technology, Bombay

(ii) Indian Institute of Science, Bangalore

MEETINGS HELD WITH

(i) INDUSTRY ASSOCIATIONS

Federation of Indian Chambers of Commerce and Industry

Associated Chambers of Commerce

Federation of Associations of Small Industries of India

Confederation of Engineering Industry

Federation of Indian Export Organisations

Bombay Chamber of Commerce & Industry

Indian Chamber of Commerce

(ii) Secretaries of Scientific Agencies/Departments and some Economic Ministries of the Government of India.

(iii) Representatives of CSIR Scientific Workers' Association and Federation of CSIR Employees and Workers Union and Associations.

(iv) Senior officials of the CSIR Headquarters and Directors of CSIR Laboratories the Committee could not visit.

(v) INDIVIDUAL EXPERTS

Prof. Satish Dhawan, Bangalore

Prof. C.N.R. Rao, Bangalore

Dr. V.S. Arunachalam, New Delhi

Dr. S. Varadarajan, New Delhi

Prof. B.D. Nag Chaudhari, Calcutta

Prof. V. Radhakrishnan, Bangalore

Prof. A.K.N. Reddy, Bangalore

Prof. S. Ramaseshan, Bangalore

Prof. S. Chandrashekhar, Bangalore

Dr. S.R. Valluri, Bangalore

Prof. P. Som, Calcutta

Prof. M.M. Chakraborty, Calcutta

Dr. A.K. Barua, Calcutta

Dr. B.B. Biswas, Calcutta

Dr. S.S. Ghosh, Calcutta

Dr. D.K. Bose, Calcutta

Prof. N.K. Chandra, Calcutta

Shri Baldev Singh, New Delhi

Dr. V. Siddhartha, New Delhi

Annexure - 3

AGE STRUCTURE OF CSIR SCIENTISTS
(Completed Age as on 1.1.1985)

	Laboratory	Dir.	Sc. F	Sc. EII	Sc. EI	Sc. C	Sc. B	Sc. B & above	Sc. A
1.	NPL	57	53	50	48	42	37	41	47
2.	CEERI	55	53	49	45	38	34	37	41
3.	CSIO	53	45	51	46	40	36	36	38
4.	NGRI	48	50	48	45	42	35	39	40
5.	NIO	50	53	48	48	43	33	36	34
6.	NCL	57	48	55	49	45	40	43	45
7.	CECRI	56	-	55	51	47	38	43	46
8.	CSMCRI	53	49	50	49	45	41	44	45
9.	RRL(H)	50	54	53	48	45	36	43	44
10.	RRL(JOR)	53	48	50	46	40	33	38	41
11.	IIP	59	48	50	46	42	36	40	43
12.	CFRI	-	54	55	49	49	45	47	44
13.	CFTRI	54	54	53	50	47	41	45	45
14.	CDRI	57	56	54	49	42	36	42	43
15.	CLRI	58	58	51	53	46	41	45	48
16.	NBRI	47	54	54	51	49	44	48	46
17.	IICB	59	55	51	48	41	38	41	49
18.	CIMAP	56	47	49	43	42	33	39	43
19.	ITRC	43	-	51	48	40	37	40	47
20.	CCMB	56	46	49	48	34	33	36	48
21.	RRL(JAM)	56	-	52	48	45	37	42	44
22.	CFB	-	52	-	47	35	35	36	33
23.	IMT	59	-	-	41	34	30	35	-
24.	CBRI	51	50	52	47	44	40	43	39
25.	CRRI	49	54	51	48	48	43	45	48
26.	CGCRI	56	51	51	50	46	39	43	46
27.	CMRS	53	45	50	48	47	43	46	44
28.	CMERI	54	46	51	45	42	41	42	46
29.	NEERI	47	52	55	47	43	40	43	45
30.	SERC(M)	53	50	50	42	39	29	37	-
31.	RRL (BHU)	53	-	51	44	38	33	36	40
32.	RRL(T)	49	-	-	41	39	36	37	43
33.	RRL (BHO)	41	-	52	38	35	29	34	-
34.	PID	59	-	56	55	48	41	46	46
35.	INSDOC	-	-	58	53	48	44	47	46
36.	NISTADS	61	57	-	40	36	32	37	-
37.	CSIR HQ	50	51	54	49	45	43	46	48
TOTAL:(37 LABS)		53	51	52	48	44	38	42	44

1983 DATA		Dir. & Sc. F	Sc.EI & EII	Sc. C	Sc. B	Sc. B & above	Sc. A
38.	NAL	50	48	42	40	42	46
39.	NML	54	53	49	46	49	46
40.	SERC(R)	48	50	46	38	42	43

Annexure - 4

EXPENDITURE OF AND CASH FLOW THROUGH CSIR

(Rs. Crore)

Year	Expenditure			Cash Flow Through Contract Research Actual/(% of Exp.)	
	Non-Plan	Plan	Total		
1981-82	48.20	37.50	85.70	7.79	(9.089)
1982-83	56.10	45.50	101.60	14.18	(13.956)
1983-84	61.90	50.20	112.10	17.08	(15.236)
1984-85	70.80	58.80	129.60	14.90	(11.496)
1985-86	97.90	66.80	164.70	20.08	(12.191)
Total	334.90	258.80	593.70	74.03	

Annexure - 5

PROJECT BUDGETING COSTING & ACCOUNTING

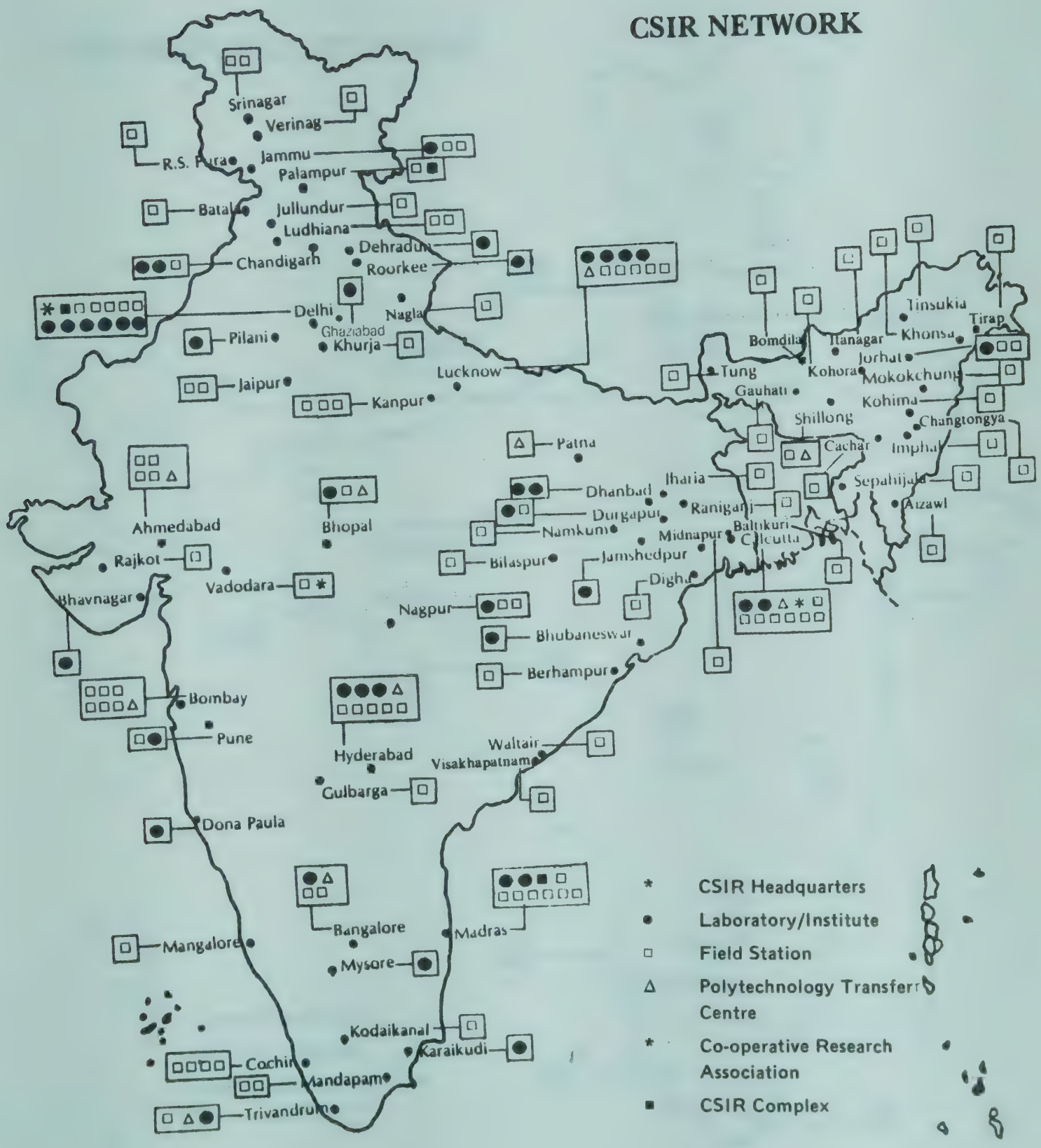
	PROJECT BUDGETING			PROJECT ACCOUNTING			PROJECT COSTING		
LAB NAME	*AP	MP	SP	AP	MP	SP	AP	MP	SP
CFRI	x			x					x
CFTRI			x			x			x
CGCRI			x			x			x
CIMAP	x								
CMERI	x					x			
CMRS			x						
CRRI		x				x		x	
IICB	x					x			
ITRC	x								
NAL	x			x					
NBRI	x			x			x		
NEERI	x								
NGRI	x			x					
NIO	x					x		x	
RRL (BHO)	x								
RRL (BHU)	x			x					x
RRL (H)	x					x			
RRL (JM)	x							x	
RRL (JOR)		x				x			x
SERC (M)	x							x	

SOURCE : NISTADS

* AP= ALL PROJECTS, MP=MOST PROJECTS, SP=SOME PROJECTS

Annexure - 6

CSIR NETWORK



Schematic diagram not to scale

Annexure - 7

SUGGESTED CSIR NETWORK

Schematic diagram not to scale